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OUTLINES

OF

NATURAL THEOLOGY,

FOR THE USE OF

THE CANADIAN STUDENT,

SELECTED AND ARRANGED FROM THE MOST AUTHENTIC SOURCES,

BY

JAMES BOVELL, M.D.,

PROFESSOR OF NATURAL THEOLOGY IN TRINITY COLLEGE, TORONTO, C. W.

TORONTO:

PRINTED BY ROWSELL & ELLIS.

1859.

BOVELL. J

THIS WORK IS INSCRIBED

TO

THE RIGHT REVEREND JOHN STRACHAN, D.D.,

FOUNDER OF TRINITY COLLEGE, TORONTO, C.W.,

THE RIGHT REVEREND THOMAS PARRY, D.D.,

VISITOR OF CODRINGTON COLLEGE, BARBADOS, W. I.,

AND THE OTHER COLONIAL BISHOPS AND CLERGY OF THE HOLY CATHOLIC CHURCH OF ENGLAND, WHO BY THEIR PIETY, EARNEST ZEAL, AND SELF-DENIAL FOR THE RELIGION OF

JESUS CHRIST,

HAVE BEEN MAINLY INSTRUMENTAL IN PLANTING IN THE COLONIES

OF

THE BRITISH EMPIRE,

THE FAITH ONCE DELIVERED TO THE SAINTS.

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WORKS OF REFERENCE.

The Student is reminded that, in our young country, Works of Reference are not easily procured; therefore it was thought advisable to adhere as much as possible to the language of authors, whenever their opinions were quoted.

The following is a list of the authorities quoted in the text:

ARCHER BUTLER's Lectures on Ancient Philosophy.

VICTOR COUSIN's History of Modern Philosophy, Eng. Ed.

SIR W. HAMILTON's Philosophy of Common Sense.

CALDERWOOD's Philosophy of the Infinite.

REID's Philosophy.

HARRIS's Pre-Adamite Earth.

COMTE's Positive Philosophy (Martineau).

CHALYBAUS' History of Philosophy.

MORELL's Modern Philosophy.

Timæus of PLATO.

HUMBOLDT's Works, Cosmos and Views of Nature.

HUGH MILLER's Works, Testimony of Rocks, and Foot-prints.

LYELL's Principles of Geology.

DE LA BEECHE's Geological Observer.

MURCHISON's Siluria.

BETE JUKES' Geology

DARWIN's Zoology.

OWEN's British Fossils.

LIVINGSTONE's Africa.

COMBE's Phrenology.

SEYFFARTH's Scripture Cosmology.

HICKOCK's Rational Cosmos.

SOLLY on the Brain.

KNOX's Edition of Edwards' Natural History.

CARPENTER's Physiology.

DRAPER's Do.

AGASSIZ' Do.

RICHARDSON's Do.

MANTELL's Wonders and Medals of Creation.

Cyclopædia of Natural History.

LATHAM's Man and his Migrations, &c.

PRICHARD's Natural History of Man.

SMITH's Human Species.

Types of Mankind (Glyddon and Nott.)

Indigenous Races of Men. Do.

MORTON's Crania Americana.

GUYOT's Earth and Man.

MANSEL's Bampton Lectures.

Prof. WILSON's Pre-historic Annals.

Dr. WILLIAMS' Physiology.

HUXLEY on Cell-growth.

Dr. LAYCOCK on Cerebral Action

ERRATA.

For Lebnitz,	*read*	Leibnitz,	page 6.
" Morrell,	"	Morell,	" 127.
" Le Marc,	"	L'Marck,	" 400.
" Synchionism,	"	Synchronism,	" 308.
" Occepital,	"	Occipital,	" 426.
" Camus,	"	Ramus,	" 426.
" Archy-type,	"	Archetype,	" 104.
" Title,	"	Tittle,	" 315.
" ζκη,	"	Ζώη,	" 48.
" περν,	"	περι,	" 230.

INTRODUCTION.

The present work is undertaken with a view to induce the Canadian Student to engage in the study of natural science, and to contemplate the works of creation, with the object of deducing therefrom principles calculated to improve the mind, and to furnish the moral nature with such food for reflection as may tend to elevate and adorn, rather than degrade and corrupt it. In arranging, compiling, and collecting, from authentic sources, the facts which have been brought forward, the principal aim of the writer has been, to prove not only that the creation of the world has been the work of a Mighty Creator, but that the revelation which has been made to us, by inspired writers, of the method and order of that creation, need not be considered as false, and that the proofs rather tend to support and confirm the Mosaic History. In treating so vast a subject, we have constantly striven to recollect, that the plan sketched out is merely in outline: if therefore we have dwelt with too much precision on some points, it is only becauso we believe that such needed greater elaboration, being those on which, or about which, there was greater controversy. In mixing with our fellow creatures, the startling conviction comes upon us, that numbers are living in a state of practical infidelity, and seem to be careless whether their opinions are erroneous, or just and true according to the standard of revealed truth. Our endeavour, therefore, should be to persuade them to enquire and to discover whether they are right or wrong. If any one should be led to contemplate the structure and operations of his own nature, and the relation which that nature has to others, we believe that he will rise from the study convinced, not only that there is a reality in his own life and in the life of others—which cannot be annihilated, but also that there is, distinct from and above all, a Self-Existent and Primary Energy. Let a man be ever so blind to the manifestation of God in his own consciousness, he can hardly shut his eyes to the innumerable evidences of His working, which meet him every where in creation. For He who is presented to consciousness as the Absolute, is manifested in nature as the Infinite Energy. The knowledge of Him is given by intuition in the one case, and by generalisation in the other. It is limited in both by the finite manifestation, and in both, therefore, it is imperfect. We have to pass from His manifestation in ourselves and in creation, to His fuller manifestation in the image of His Son. The former is the revelation of His existence ; the second of His power and wisdom ; the last, of His love. In the one, He is viewed as the unconditioned ; in the other, as the First Cause ; and, in the last, as our Father, who is in heaven.

And thus, though Natural Theology be only a step of "the world's great altar-stairs, which slope through darkness up to God ;" though it be the mere seeing—as in a glass—darkly, compared with the light of the Incarnation and the mystery of the Sacrifice ; yet, to many who doubt, it may be a pathway ; and to many who believe, another out-work to the citadel of the faith. Though the one be the reflex, the other may be the shadow of His glory.

We have, then, desired earnestly to shew forth the Almighty Ruler of the Universe, as distinct from, and superior to His works ; condescending to create beings whom he has deemed to be worthy of His constant care, and who, as reflecting His image, he permits and demands should offer Him worship. While false systems of philosophy may tantalise and fret the mind, the calm and reflecting reasoner on revealed truth is content to curb his imagination, and to accept the creator as He has thought fit to shew Himself. Satisfied of His mighty majesty, dominion, and power, he finds enough, and more than enough, to demand his homage, and to throw him into the very dust, when convicted of ingratitude and convinced of the terrible wickedness of disobedience.

Some ancient philosophies, dimly it may be, taught men that a Being exists, who through His works reveals himself, as an author in his volume: that He is the providential cause and governor of the world, and (above all portions of His creation) the special guardian of man: that He is, moreover, the legislator of rational beings, having given them laws, (harmony and numbers,) whose evident universality forbids the supposition of a partial or accidental origin; and that those laws are accompanied with sanctions of reward or punishment, to which the fact of conscience bears perpetual attestation. Can it be that, in an age in which the pure and brilliant light of Christian philosophy has been burning for more than eighteen hundred years, mankind should continue to prefer the darkness of a despairing scepticism, to that simple but inspiring reality contained in the message which brought peace on earth and good will to man?

St. George's Square, Toronto,
Canada West,
November 25, 1850.

MIDDLE LIAS SHALE.	Modiola, Plagiostoma, Gryphæa.
LIAS LIMESTONE.	Belemnites, Shells, as Gryphea incurva, Ammonites Trochus, Modiola, Pinna, Arca Buckmani, Spirifer punctatus, Plagiostoma gigantium, Cardinia ovalis, Nucula rostralis. Remains of the Ichthyosaurus and Plesiosaurus, also Fishes and Insects.
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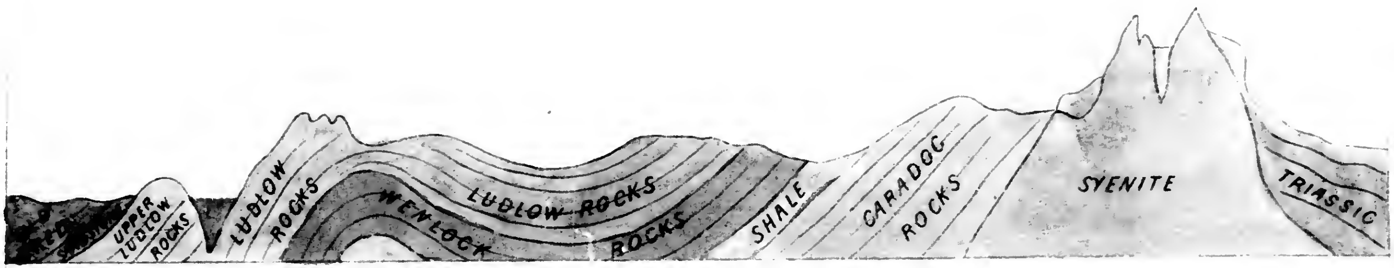
SYSTEMS AND SUBDIVISIONS.		PRINCIPAL FOSSILS.
PLEISTOCENE, OR MODERN DEPOSITS.	CAINOZOIC OR TERTIARY	Bones of Stag, Elephant, Rhinoceros, Bear, Hyæna, &c., and Shells, as Fusus, Murex, Littorina, &c.
MAMMALIFEROUS, OR NORWICH CRAG.		Bones of the Mastodon, &c. Of the Shells, about ninety per cent. are of recent species.
PLIOCENE.		
RED CRAG.		Rolled and worn bones of the Mastodon, &c. Sharks' teeth. About seventy per cent. of the Shells are of recent species.
MIOCENE.		
CORALLINE CRAG.		Corals, Zoophytes, Echinoderms, and Shells. About sixty per cent. of the Shells are of recent species.
EOCENE.		
FLUVIO-MARINE BEDS.		A few bones of Pachydermata, &c., and Shells of the genera Paludina, Potomomya, Planorbis, Murex, &c.
BARTON CLAYS.		Marine Shells, as Avicula, Bulla, Cardium, Corbula, Fusus, Modiola, Natica, Oliva, Pleurotoma.
BAGSHOT AND BRACKLESHAM SANDS.		Very few Fossils; Marine Shells, as Turritella sulcifora, Venericardia planicosta, Nummulites.
LONDON CLAY AND BOGNOR BEDS.		Bones of Crocodiles, and remains of Turtles, teeth of Sharks, Crustacea, Shells, Tropical Fruits and Seeds, &c.
[illegible]		Shells, as Ostrea [illegible] culæ, &c.
MARLSTONE.		Cycadeous, Plants, Ferns, and Shells, as Terebratula, Pecten, Avicula, Cardium, [illegible]

SILURIAN ROCKS OF HEREFORDSHIRE
AND WORCESTERSHIRE



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LOWER OOLITE.		
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SIONS.		PRINCIPAL FOSSILS.
	CAINOZOIC OR TERTIARY	Bones of Stag, Elephant, Rhinoceros, Bear, Hyæna, &c., and Shells, as Fusus, Murex, Littorina, &c.
H CRAG.		Bones of the Mastodon, &c. Of the Shells, about ninety per cent. are of recent species.
		Rolled and worn bones of the Mastodon, &c. Sharks' teeth. About seventy per cent. of the Shells are of recent species.
		Corals, Zoophytes, Echinoderms, and Shells. About sixty per cent. of the Shells are of recent species.
S.		A few bones of Pachydermata, &c., and Shells of the genera Paludina, Potomomya, Planorbis, Murex, &c.
		Marine Shells, as Avicula, Bulla, Cardium, Corbula, Fusus, Modiola, Natica, Oliva, Pleurotoma.
I SANDS.		Very few Fossils; Marine Shells, as Turritella sulcifora, Venericardia planicosta, Nummulites.
R BEDS.		Bones of Crocodiles, and remains of Turtles, teeth of Sharks, Crustacea, Shells, Tropical Fruits and Seeds, &c.
LAYS.		Shells, as Ostrea bellovicina, Melania inquinata, Cyrena cuneiformis.
	OZOIC OR SECONDARY	Fishes, Zoophytes, Echinodermata, Belemnites, Shells, as Terebratulæ, Ostreæ, Craniæ, Plagiostoma, Ammonites.
		Sponges, Echinodermata, Ammonites, Ostreæ, Terebratulæ, Inocerami.
		A few Zoophytes and Echinites, Shells, as Turrilites, Nautilus, Terebratulæ suicata, &c.
		Shells, as Ammonitits, Rhotomagensis, Ostrea carinata, Turrilites costata, Terebratula biplicata.
		Belemnites, and Shells, as Hamites rotundus, Inoceramus sulcatus, Ammonites dentatus.
		Remains of the Iguanodon, Fishes, and Shells, as Perna mulleti, Trigonia aliformis, Thetis minor, Ammonites.
		Freshwater Shell of the genera Paludina, Cypris, Cyrena, Neritina, Melanopsis.
		Bones of Reptiles, &c., as the Iguanodon, Megalosaurus, Turtles, remains of Plants, Freshwater and Estuary Shells.
		Fishes, Fossil wood, Coniferæ and Cycadeous Plants, Shells of the genera Unio, Ostrea, Physa, Cyclas, Paludina, &c.
E.		
ANDS.		Marine Shells, as Trigonio gibbosa, Terebra Portlandica; Pecten lamillosus; Remains of Cycadiform Plants.
		Lignite; Shells, as Ostrea Deltoidea, Gryphæa virgula; a few bones of Icthyosauri, scales and teeth of Fishes.
TE.		
RIT.		Ammonites vertebralis, Gryphae bullata, Isocardia tumida, Rosteleria bispinosa.
		Corals of the genera Astrea, Caryophyllia, &c, &c; Marine Shells, as Trigoniæ, Ostrea, Nerinea, Pecten, &c.
RIT.		Ammonites solaris, Pholadomya simplex. Modiola bipartita, Actæon retusus, Pinna lanceolata, Ostrea gregarea.
		Fishes; Belemnites hastatus, and Shells, as Ammonites. Jason, Nautilus, sublævis, Terebratula, Modiola, Panopea,
		Shells as Gryphæa dilatata, Ammonites calloviensis, Ammonites sublævis, Pecten fibrosus, Plagiostoma duplicatum.
E.		
		Marine Shells, as Sanguinolaria parvula, Bulla undulata, Littorina punctura, Ostrea marstrii, Anomia semistriata.
		Shells as Acrosalenia hemicidaris, Terebratula maxillata, Pecten, annulatus, Pecten vagans, Nucula Menkii.

GREAT OOLITE.	MES	Tereb Coral an Pleur
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FULLERS' EARTH.		Echinite nosa,
INFERIOR OOLITE.		Shells, T maria
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LOWER LIAS MARLS.		Remai Fishes
RED CLAYS.		A few Pl
NEW RED, OR VARIEGATED SANDSTONE.		No Fossil or Chei
PERMIAN.	PALÆOZOIC OR PRIMARY	
KNOTTINGLEY LIMESTONE.		Fossils ve
GYPSEOUS MARLS.		
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LOWER NEW RED SANDSTONE AND DOLOMITIC CONGLOMERATE.		A few Pl
CARBONIFEROUS.		
COAL MEASURES.		Plants, as opteris,
MILLSTONE GRIT.		Ferns, Sig
MOUNTAIN LIMESTONE.		Crinoidea Euomp
LIMESTONE SHALES.		Plants an
DEVONIAN.		
QUARTZOSE CONGLOMERATES.		Fish, Hol
CORNSTONE AND MARL.		Fish, Cep
TILESTONE SERIES.		Fishes, a
UPPER SILURIAN.		
LUDLOW ROCKS.		Shells, as feræ, O
WENLOCK ROCKS.		Trilobites Corals, discors,
LOWER SILURIAN.		
CARADOC ROCKS.		A few Co Pentam
LLANDEILO OR BALA ROCKS.		Corals, as Asaphu
CAMBRIAN.		
SNOWDEN, SKIDDAW, BANGOR, AND OTHER SLATE ROCKS.		Mollusca, and Ar
MICA SCHIST.	HYPOZOIC	
GNEISS.		No Organ
GRANITE.		

...Pecten vagans, Nucula Menkii.

MES

...rinites, as Apiocrinites rotundus, Serpulæ; Shells, as Terebratula digona.

Coral and Shells, as Terebratula globata, Turbo costarius, Pleurotomaria conoidea, Ammonites, Nautilus.

Bones of Mammalia and Reptiles; Land Plants, Insects, Astacideæ, Belemnites; and Shells, as Avicula ovata.

Echinites and Shells, Lysianassa literata, Terebratula spinosa, Terebratula ornithocephala.

Shells, Terebratula spinosa, Pholadomya fiducula, Pleurotomaria ornata, Ostrea Marshii, Trigonia costata.

Saurian remains, as Icthyosaurus, Plesiosaurus; Fishes, Crinoidea, Belemnities, and Shells, as Ammonites, Nuculæ, &c.

Cycadeous, Plants, Ferns, and Shells, as Terebratula, Pecten, Avicula, Cardium, Modiola, Plagiostoma, Gryphæa.

Belemnites, Shells, as Gryphea incurva, Ammonites Trochus, Modiola, Pinna, Arca Buckmani, Spirifer punctatus, Plagiostoma gigantium, Cardinia ovalis, Nucula rostralis. Remains of the Ichthyosaurus and Plesiosaurus, also Fishes and Insects.

A few Plants.

...TONE. — No Fossils. Footsteps of Animals, as the Labyrinthodon, or Cheirotherium.

PALÆOZOIC OR PRIMARY

Fossils very rare, a few marine Shells.

Marine Shells, Productus calvus, Spirifer undulatus, Mytilus septifer, Cucullœa Sulcata, Axinus obscurus.

Fossil Fish of the genera Palæoniscus, Pygopterus, Cœlacanthus and Platysomus. Algæ and Ferns.

...E

A few Plants, as Calamites, and Sigillaria.

Plants, as Sigillaria, Calamities, Ferns, as Pecopteris, Sphenopteris, and Shells, as Cypris inflata, Ammonites listeri.

Ferns, Sigillariæ, Calamites, Zoophyta, Conchifera, Mollusca.

Crinoidea, Polyparia, and Shells, as Producta gigantea, Euomphalus catillus, Spirifer striatus.

Plants and Shells.

...S. — Fish, Holoptycchius nobilissimus.

Fish, Cephalaspis and Onchus.

Fishes, as Dipterus, &c., and remains of Testacea.

Shells, as Pentamerus Knightii, Lingulæ, Orbiculæ, Spiriferæ, Orthis.

Trilobites, Echinodermata, as Actinocrinus moniliformis; Corals, as Catenipora escharoides; Shells a Euomphalus discors, Orthoceras annulatum.

A few Corals and Crinoidea, Trilobites; and Shells, as Pentamerus lævis, Orthis grandis, Nucula, Tentaculites.

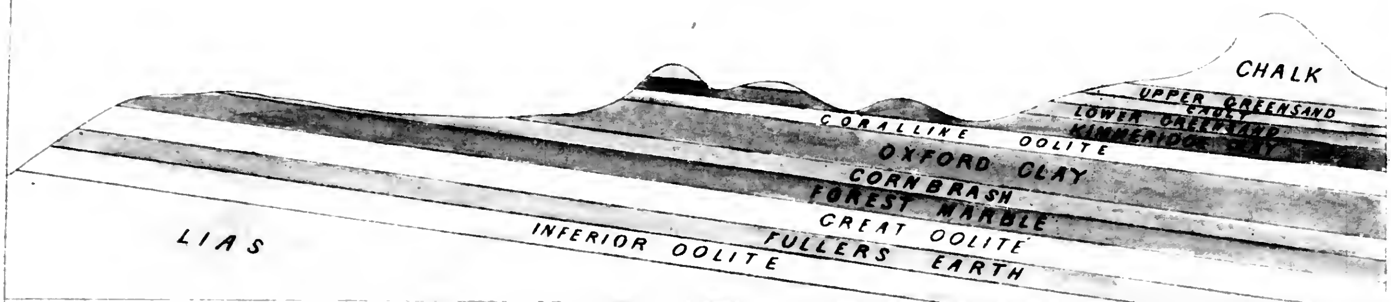
Corals, as Catenipora; Shells; and Crustacea, as Trilobites, Asaphus Buchii, &c. and Graptolites.

...R, — Mollusca, as Lingulæ and Crustacea, a few Corals, Fuci, and Annelids

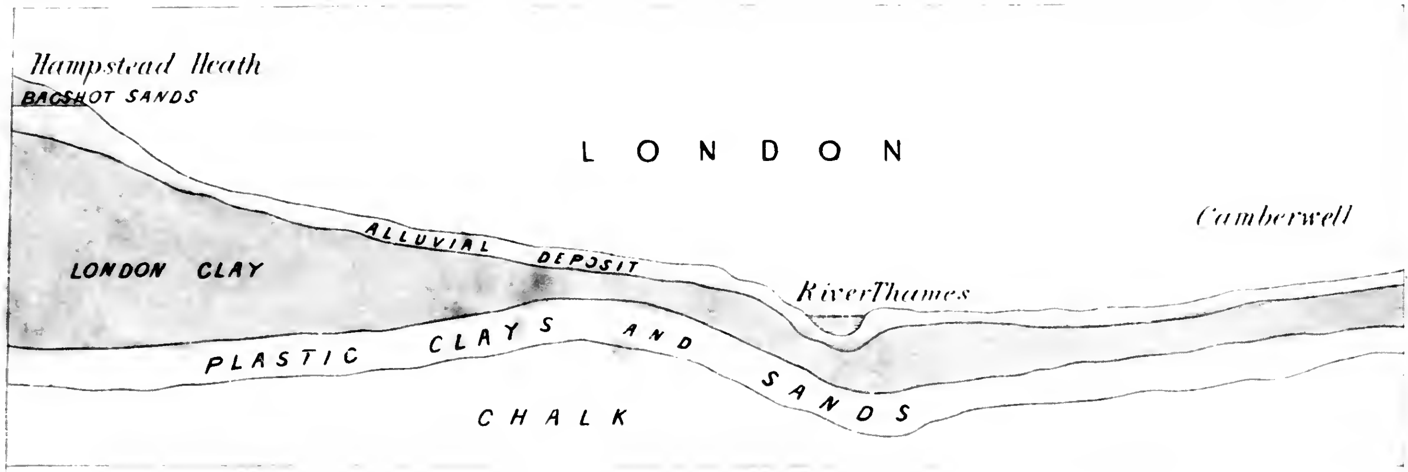
HYPOZOIC

No Organic Remaines yet disovered.

OOLITE OF SOMERSETSHIRE



SECONDARY STRATA



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NATURAL THEOLOGY.

BOOK FIRST.

Mankind at large have naturally some belief; hence we discover that there are two great classes in the world, the one having a firm conviction of the existence of a Supreme All-wise Creator, the other class, which permits of many sub-divisions, comprising those who believe in the eternity of all things, those who deny the existence of an *intelligent* First Cause, and of a third party, who suppose a First Cause which is so intimately mixed up with its creations as to be lost in them, thus declaring a belief not only in the eternity of matter and its cause, but in the oneness of both. There can be no doubt that the conflicting and erroneous opinions which so unfortunately divide the family of man are to be traced to the systems of philosophy which from early times have taken possession of the schools, and which have invariably exercised their influence for evil in proportion as religion was put away, and its place supplied by cold morality. At this very time we may easily trace the revival in the schools of the doctrines of Spinosa, Lebnitz, Locke, and an emasculated Platonism, all exercising an immense influence on the different nationalities of Europe and America, and the influence of these philosophies predominating as religion is put aside. We look in vain for the impress of a system of philosophy based on Christianity, a system which, assuming the revelation of God to man to be true, examines the grounds and proofs of that revelation, and on such a foundation proceeds to raise a superstructure.

"With all our admiration," says Butler, "for the energetic labours of the great naturalists of our day, and for the advances which the physical sciences are receiving through their combined exertions, we cannot refuse to see—and in all quarters the conviction is gaining ground among thoughtful men—that the spiritual world (except as far as *practically* presented by the preachers of religion) is in proportion eclipsed. It is, as it were, unrepresented in the parliament of philosophy."

It matters little to the sceptic whether we invite him to discuss the evidence for the existence of an intelligent First Cause—which may or may not be independent of its effects—or whether we set before him a God self-existent, eternal, all-wise, omnipresent, absolutely perfect—one to be adored and worshipped by creatures who enjoy endless immortality. The God of the Christian believer is not acknowledged by the pantheist or atheist: therefore nothing is gained by withholding any part of our article of faith, which includes a full declaration and acknowledgment of all those attributes which are given to the Supreme Being in Holy Writ, and the relation which that incomprehensible Being has to his creatures and his creatures to him.

"It is very remote from my inclination," says Mr. Crombie, "to insinuate even a censure on the reasonings of men distinguished by science, eminent for piety, and zealous in promoting the interests of religion and truth. But I must candidly own that the metaphysical speculations in which some theologians and philosophers have indulged, respecting the mode of the divine existence, have appeared to me likely to obscure the subject which they meant to illustrate, and to injure the cause which they were solicitous to promote. The mode in which the Supreme Being exists, in which he is every where present, and in which by his power he created and rules the universe, are, and ever must remain, subjects too profound for the faculties of man to investigate or comprehend. They are veiled in impenetrable obscurity." Again, he further remarks, "If we are desirous to avoid error, and to arrive at truth, we must be careful to survey every subject of discussion, not only in the light in which one author or one party presents it to our examination, but in that also in which their opponents propose it to be viewed. Every man has reason to suspect the justness of his conclusions who confines his attention exclusively to the evidence which is favourable to one side of a question; and he is equally a bigot in philosophy as in religion, who is obstinately wedded to a doctrine which he has only partially examined. If it be necessary to disengage our understandings from the prejudices of education, which, by presenting to us objects of speculation invariably in the same light, exclude those views which would enable us to rectify our judgment and correct our errors; it is equally requisite, on the other hand, when we have shaken off the dominion of these, to beware lest we become the dupes of others, not less injurious, maintaining opinions founded in partial evidence and partial inquiry." Had Sir Isaac Newton been more mindful of the authority of Christian philosophy, as embodied in Scripture, he would not have represented *space* as if it were the "*sensorium*" of the Deity. Spinosa would not have uttered the horrible assertion, that "the universe is Deity." Dr. More never would have represented him as "*Spatium tribus dimensionibus præditum;*" nor would Dr. Clarke have said, "that space and time are real quantities, and not the mere order of things, * * and that God is present every where, not virtually only, but substantially, because power cannot subsist without substance;" thus declaring that an Omnipotent Being must be substantially present, in order to accomplish the purposes of his will.

In the very opening clause of the charter of man's hopes his faith is at once challenged, and in language the most simple and sublime the majesty of a Creator is proclaimed, and the origin of all things by his will unequivocally asserted. But—as if this were not sufficient to excite his curiosity and compel attention—the precise method and order of creation is detailed, and at the close of the brief narrative the immortality of a race of creatures is declared. The advent of man is not the first in order, but the first in position: he is not only the last of the creation, but the completion of the great work, so far as it is accomplished: a being capable of reasoning on the past and of contemplating the future. We find such an one taking up his abode not in a barren world; but, standing on the sepulchre of worlds, man, the foretold of the past, the glory and promise of the future, takes his place. He is not found in the ancient graveyards—he comes not until the plan of creation of animal life is all but complete. No! he is not found even with those giant forms which some imagine to have lived even to his advent, and amongst whom lie the ashes of beings of their own day, and the entombed remains of worlds long since demolished. Man has then a deep interest in these questions, and is freely permitted and incited to make enquiry into the origin of things, so that men shall speak of his marvellous acts who made them; "for all thy works praise thee, O Lord." The works of the Lord are great: sought out of all them that have pleasure therein, the merciful and gracious Lord has so done his marvellous works that they ought to be had in remembrance. For the invisible things of him from the creation are plainly seen, being understood by the things that are made, *even* his eternal power and Godhead: so that they are without excuse. To enquire, therefore, is not only a privilege, it is a duty; but in entering on such a momentous inquiry, surely it becomes us reverently and thankfully to undertake so wholesome and pleasurable a task, not with a predetermination to doubt, and at length disbelieve what we cannot instantly prove, but rather with a distrust of our own finite capacities, and the recollection that but too often the splendid fictions of philosophers, which have seduced thousands into error, disappear one by one, and leave sceptic and believer alike astonished and confounded.

In entering, then, on the enquiry, What is the origin and what is the object of creation? we shall prefer to take as a basis for the investigation the expressive description which is given in a record which a very large class of men in all ages has been content to accept as containing an authentic narration of events connected with the world's history. We find in the statement referred to several dogmatic assertions, either and all of which sufficiently meet the views of the sceptic as starting points from which he may assail the believer, and the believer answer the sceptic. Thus it is said—

"In the beginning God created the heavens and the earth; and the earth WAS without form and void; and darkness was on the face of the deep. And the spirit of God moved ON THE FACE OF THE WATERS."

We have then two important declarations: first, that there was a beginning of things; and, secondly, that all things were created by a God or Being, who, as the subsequent portions of the narrative emphatically pronounce, proceeded in the creation of all things by the fulness of his power in a systematic and orderly manner; thirdly, that our epoch was a re-formation of the earth, a re-fitting it for the human period.

We are content therefore to make use of the history of the earth, detailed in the Mosaic records, as our starting point; for although it be brief, it is nevertheless explicit, and has hitherto been accepted as a divinely inspired record of facts and events which took place at a given time, for and within a stated period. Before, therefore, we acquiesce in the opinions of those who deem it to be impossible to reconcile the sacred account of the present creation with the supposed requirements of geological and astronomical science, it should be distinctly shewn that such a reconciliation cannot be attained, and that the supposed proofs advanced by the professors of these sciences are valid and true. We can discover but little difference between the thorough disbeliever, and the sceptic who endeavours to explain away the simple language of the scriptural account of the creation; for although it be true that, with reference to the history of certain events in Holy Writ, the literal meaning may be departed from, nevertheless in such instances the context, or collateral passage, or other references elsewhere given, guide to a correct conclusion. We unhesitatingly express our sincere conviction of the literal meaning and accuracy of the descriptions given in the Book of Genesis, and find it more difficult to receive as truth the fanciful theories of the lamented Hugh Miller, than the unadorned record of a Moses.

How the vulgar belief of the creation arose seems altogether unaccountable, and serves only to point out to the thoughtful student that his eyes may be holden from the truth, and his mind led captive by unrealities. Mankind, with the Scriptures before them for centuries, have from age to age believed and taught that this globe of ours was brought into existence for the first time five days before the creation of man; and yet it is positively affirmed that it was in existence before the first day. Who can tell the countless ages which elapsed ere the shapeless *earth*, buried in the depths of an ocean, was lifted up into mountain and valley, hill and dale, touched by the Spirit which parted the waters from the waters, and which divided the waters which were under the firmament *from the waters which were above the firmament*, rolling back the funereal pall which must during a long midnight have shrouded it in utter darkness, and have excluded that light which was commanded or made to dispel so horrible a gloom. Who can yet measure the accurate duration of those periods, each of which was occupied with the peculiar life forms which preceded the advent of man; or who can recount the number of epochs which, far back in the night of time, commenced the wondrous scheme of life, which rolling on and on through each succeeding age, was more perfectly developed, until at length perfection was attained, and "God's own image," fashioned of the earth and blessed with immortality, became at once the glory and the special care of his Maker and of angels.

Now looking on the Bible as the book of divine law sent from God to man to inform him of his high destiny, and to demand willing obedience and holy worship, we ought not to expect to find its pages encumbered with learned disquisitions on matters of science; and it surely is sufficient if we find that even where the sacred writers do bring out points which involve the most subtle problems of physical science, that they have not cared to conceal beneath artfully turned sentences or equivocal expressions statements which could not be proved or doctrines impossible to be received. The language employed by Moses in introducing the history of the creation is not only sublime, but so astonishingly simple as from its very simplicity to convince us that he desired neither to detail a fiction or to gloss a truth. As a writer of a divine revelation he was mindful of such facts as immediately concerned the human family in their relationship to the world around them and to the author of their being, and was in no way concerned in any thing which transpired in or belonged to those other previous creations which preceded his own. Moses therefore gives clear testimony of his inspiration when he informs his co-mortals that before they were created, the earth which they inhabit was engulphed in water and shrouded in a dense vapourous mass, excluding light, and that it was expressly fitted and renovated and created anew for their use ; for the earth there was renovation, for organized beings there was creation.

We are naturally led to enquire whether there are any proofs of a display of creative power? Secondly, whether an intelligent power is not revealed as having devised a plan and observed order in the execution of that plan, and which has been carried out with marvellous harmony and wisdom? Thirdly, can we furnish evidence of there having been special acts of creation at different times or periods, new beings created and introduced into the world at new and particular epochs of its history?

Do we any any where discover then a display of creative power? It is said that nothing necessarily exists but time and space. Perhaps it would be much nearer truth to say that nothing necessarily exists but Cause—self-existence, power or will—time and space being but necessary conceptions of the human mind; for if it be impossible to conceive of body without space, so is it equally impossible to conceive of the existence of body *in* space without power or will to place it there. This is well shewn in the argument advanced by M. Cousin. "You have," he says, "the idea of a body, you believe that it exists, but can you suppose it not to exist? I ask you can you not suppose this book to be destroyed? Without doubt you can; and can you not also suppose the whole world to be destroyed, and no body whatever to be in existence? You can. For you, constituted as you are, the supposition of the non-existence of bodies implies no contradiction; and what do you call the idea of a thing which we can conceive as non-existing? We call it a contingent and relative idea. But if you can suppose this book to be destroyed, the world destroyed, all matter destroyed; can you suppose that when all bodies should cease to exist, there would no longer remain any space for bodies which might come into existence?

You cannot. If it is in the power of man's thought to suppose the non-existence of bodies, it is not in his power to suppose the non-existence of space: the idea of space is then an absolute and necessary idea. Here then are two characters entirely different which separate the two ideas of body and space." It is clear that M. Cousin admits the idea of power as a necessary idea, although in the paragraph he had not expressly enumerated it: for we cannot possibly conceive of the destruction of body without the necessary conceptions of power adequate to the task of destruction; nor can we conceive body in space without power to create and retain it in space. Professor Hamilton, in treating of the same idea, does not commit the same error, he says, space, or extension, is a necessary form of thought. We cannot think it as non-existent; we cannot but think it as existent. But we are not so necessitated to imagine the reality of ought occupying space; for while unable to conceive as null the space in which the material universe exists, the material universe itself *we can* without difficulty annihilate in thought, and if we can in thought annihilate, we must conceive the power to annihilate. All that exists in, all that occupies, space, becomes therefore known to us by experience: we conceive, we construct its notion. The notion of space is thus native, or, *a priori*, the notion of what space contains adventitious, or *a posteriori*; of this latter class is that of body or matter." The lamented author of "The Pre-Adamite Earth" has set this matter in a much clearer light than any other writer with whom we are acquainted." He observes, "That the first stage of creation, as it exhibited the existence of matter in motion, involved at least three necessary truths. For *we cannot* conceive of succession, without time; of body, without space, nor of effect *without the power which caused it*, i.e., a being or substance potential to the effect produced. Time, space, *power* are necessary ideas. All phenomena presuppose them ; are not intelligible without them ; they themselves cannot be resolved into any thing antecedent; have no conceivable conditions, but exist independently of every thing else. Here an important distinction comes to light. While space is only the condition of body, and time of motion, power, as we have implied, is not only the condition, *but the cause of both ;* as condition, it could not but be ; as cause, its existence was contingent on the Divine will. As condition, it was from eternity ; as cause, it commenced the succession of immeasurable time. As condition, it is the condition of the infinite substance, an attribute of the Divine nature ; as cause, it is the objective manifestation of that property, the creating exercise of that attribute. As condition, its activity from eternity was only subjective ; as cause, its activity becomes objective also. Here then we have the *subjective* and the *objective;* for that which was possible has become real. What must that be, *to which the real has always been possible?* and what is that which having been only possible has now become real? What are the relations between the two? or how do they co-exist? This is the domain of ontology—the doctrine which relates to the substance of being. Whether Mr. Harris borrowed these ideas or not from others matters little, they are re-introduced to us by a wise and good man, and may seem to strengthen our conviction by their similarity. In Archer Butler's excellent lectures on the History of Philosophy, he gives the following commentary on Plato's conception of *time*, in which is included the manifestation of power so visibly developed as to lead one to suppose that the mind of the philosopher was dwelling much more on its conception: "This was considered to have been created with the rest of the sensible world, to finish with it, if it ever finish—to be altogether relative to this phenomenal scene." Again, "the generating Father," says Timæus, "having beheld this created image of the invisible powers in life and motion, rejoiced at the sight, (saw that it was good,) and in his delight thought to make it still more resemble its model; and this being a living thing, he endeavoured to give the universe this sort of completeness as far as might be. The nature of the exemplar animal was eternal; and it was impracticable to adapt this character to any thing created, without qualification; he determined therefore to create a moving image of *eternity*, (εἰκώ κινητόν τινα αἰῶνος,) and in disposing the heavens he framed of this eternity—reposing in its own unchangeable *unity*—an eternal *image*, moving according to numerical succession, which we call *time*. With world arose days, nights, months, years, which all had no previous existence ; the past and future are but forms of time which we most erroneously transform to the eternal substance : we say it *was*, and *is*, and *will be*, whereas we can only fitly say *it is*. Past and future are appropriate to the successive nature of generated beings, for they bespeak motion ; but the Being eternally, unmovedly the same, is subject neither to growth nor to age, nor to any other accident of time ; it neither was, nor hath been, nor will be, which are the attributes of fleeting sense—the circumstances of time imitating eternity, in the shape of number and motion. Nor can any thing be more inaccurate than to apply the term real being (το εἶναι) to past, or present, or future, or even to non-existence (τὸ μὴ ὄν). Of this, however, we cannot speak more fully now. *Time*, then, *was formed* with the heavens, that, together created, they may together *end;* if, indeed, *an end* be in the purpose of the Creator ; and it is designed as closely as possible to resemble the eternal nature, its exemplar. *The model exists* through all eternity. The world has been, and is, and will be through all *time*." He, continues Plutarch, and others in various ages, have made the attempt to demonstrate that the "Ideas" of Plato were not meant as distinct realities at all, but simply as models conceived in the mind of God, in the same manner as models are imagined in the mind of man. The operation of the Deity is thus conformable to ideas, in being the shadowing in the world of sense of his conceptions of order.

This carries with it the attraction of simplicity, but it is utterly inconsistent with the assertions of Plato, which every where, and in every form, distinguish between the reality of eternal forms and the mere conceptions of the mind. Holding that the "Ideas" are intimately incorporated in creation, being its very life and substance, Plato could not, without *identifying the Deity with his work*, regard *them* as in any sense a portion of the Divine Nature itself. These "forms," or eternal laws of things, are above us, but they are below God; and though they point to us the character of the Supreme Essence of Essences, they are not to be worshipped as him. Nor are these laws only existent in his intellect, for then where were "Creation." But he is the cause, and sustainer, and substance of laws. Here, then, is briefly Plato's opinion—there exist, and existed before the formation of the universe, three distinct principles, being, place, and production: that is to say, the real, which we know is essentially eternal; the nature, which received the subsequent sensible creation ; and the creative principle, which was prepared, as it were, to project the eternal and invisible in the forms of time and sense.

"To treat of power," says M. Cousin, " is to treat of cause. Let us not forget that the belief in the world and in external causes is universal and necessary, and that the fact which explains it must itself be a necessary and universal fact. If, then, our belief in the world and in exterior causes resolves itself into the assimilation of these causes to our own, this assimilation must be a necessary and universal fact. Now look to physiology : I expect that it will prove that all intellectual and moral beings conceive external causes by reason of their own, as endowed with consciousness and animated : I look to it to prove that this opinion of children and savages is not only a frequent fact, but a universal fact, and that there is not a child, not a savage, who does not thus begin. And when it shall have proved that this fact is universal, it must necessarily go still further : it must necessarily prove that this fact is not only universal, but that it is necessary. But the character of a necessary fact is, that it must unavoidably exist ; and the necessity of an *idea*, of a *law*, implies the denomination of that idea, of that law, in the whole extent of its duration, and so long as the human mind subsists. * * * We all have the perfect conviction that this world exists, that there are external causes ; and these causes we believe to be neither personal nor voluntary. This is the belief of the human race: it belongs to philosophy to explain it, without destroying it, without altering it." "Let us," says Sir William Hamilton, "form to ourselves a concept of the universe. Now *we are unable to think* that the *quantity* of existence, of which the universe is conceived *the sum*, can either be amplified or diminished. We are able to conceive the creation of a world: this indeed as easily as the creation of an atom. But what is our thought of creation? It is not a thought of the mere springing of nothing into something. On the contrary, creation is conceived, and is conceivable by us, only as the evolution of existence from *possibility* into *actuality*, by the *fiat* of the Deity. Let us place ourselves in imagination at its very crisis. Now, can we construe it to thought, that the moment after the universe flashed into material reality, into manifested being, that there was a larger compliment of existence in the universe, and its author together, than the moment before there subsisted in the Deity alone? This we are unable to imagine. And what is true of our concept of creation, holds of our concept of annihilation. We can think no real annihilation, no absolute sinking of something into nothing. But as creation is cogitable by us, only as a putting forth of divine power, so is annihilation by us conceivable as a withdrawal of that same power. *All* *that is now actually existent in the universe, this we think and must think, as having, prior to creation, virtually* existed in the Creator; and in imagining the universe to be annihilated, we can only conceive this, as the retraction by the Deity of an overt energy into latent power." To this doctrine we demur, since it places a limit on Creative Power. Power is above creation, or the created, as cause is superior to the caused; we can think real annihilation, as Cousin affirms, and as Sir William himself virtually admits, when he says, "as creation is cogitable to us as a putting forth of divine power, annihilation the withdrawal of divine power;" but unless it be proved that cause and effect are the same, we cannot comprehend how we are bound necessarily to believe that "all that is now actually existent in the universe, we must think as having, prior to creation, *virtually* existed in the Creator." It is manifestly not so. The Creative Power is absolute, all-comprehensive, capable of accomplishing what it wills, even in its absolute, unrestrainable omnipotence to create that which is not itself, but exists only by virtue of its will. Whether we turn our attention, says Cousin, to the forces and the laws that animate and govern matter without belonging to it, or as the order of our labour calls us to do, reflect upon the universal and necessary truths which our mind discovers, but does not constitute, the least systematic use of reason makes us naturally conclude from the forces and laws of the universe that there is a first intelligent mover, and from necessary truths that there is a necessary being who alone is their substance. We do not perceive God, but we can conceive him, upon the faith of this admirable world exposed to our view, and upon that of this other world, more admirable still, which we bear in ourselves. By this double road we succeed in going to God. This natural course is that of all men: it must be sufficient for a sound philosophy. But there are feeble and presumptuous minds that do not know how to go thus far, or do not know how to stop there. Confined to experience, they do not dare to conclude from what they see in what they do not see; as if at all times, at the sight of the first phenomenon that appears to their eyes, they did not admit that this phenomenon has a cause, even when this cause does not come within reach of their senses. They do not perceive it, yet they believe in it, for the simple reason that they necessarily conceive it. Man and the universe are also facts that cannot but have a cause, although this cause may neither be seen by the eye nor touched by our hands. Reason has been given us for the very purpose of going, and without any circuit of reasoning, from the visible to the invisible—from the finite to the infinite—from the imperfect to the perfect, and also from necessary and universal truths, which surround us on every side, to their eternal and necessary principle. Such is the legitimate and natural bearing of reason. It possesses an evidence of which it renders no account, and is not thereby less irresistible to whomsoever does not undertake to contest with God the veracity of the faculties which he has received. But one does not revolt against reason with impunity. It punishes our false wisdom by giving us up to extravagance. When one has confined himself to the narrow limits of what he directly perceives, he is smothered by these limits, wishes to go out of them at any price, and invokes some other means of knowing; he did not dare to admit the existence of an invisible God, and now behold him aspiring to enter into immediate communication with him, as with sensible objects and the objects of consciousness. It is an extreme for a rational being thus to doubt reason, and it is an incredible rashness, in this despair of intelligence, to dream of direct communication with God. This desperate and ambitious dream is mysticism.

What, then, is the true relationship which the Creator has to his works? It is in answering this question that we require to be especially careful, least we find ourself involved in error, for on the one hand we may deny the omnipresence of the Deity, or on the other may easily fall into the opinions of pantheism, and merge the Creator in his works.

One great value of adhering to the Mosaic account is, that we get absolute proof of creative interference; for if geology did not inform us that the earth had been replenished many times, we should have had difficulty in refuting the perpetual succession of life. "One important distinction," observes Dr. Harris, "is disclosed to us under the law relating to truth—the distinction between the subjective and the objective; the infinite mind and the created universe; the latter presupposing the former *having existed potentially in the* mind of God before it existed objectively as a purpose realized." "Let us," observes Mr. Calderwood, "imagine that we stand at the point of creation, and perceive the material universe dart into existence—the actual commencement of material substance. What have we here? We are conscious of the origin of this new existence; we necessarily think that it had a cause—that some operating power has brought it into existence. But do we think that this material substance previously existed in the cause? Do we think that the cause is material? By the nature of the case it is impossible. By our consciousness the statement is false." But, says Sir William Hamilton, we cannot conceive of nothing becoming something. Certainly not, for that were to think nothing, which is impossible. Well, then, he continues, creation is conceived, and is by us conceivable, only as the evolution of existence from possibility into actuality by the fiat of the Deity. What have we here? "The evolution of existence from possibility into actuality." What is existence?

It is nothing except in so far as an individual existence is indicated. In this case, therefore, it is either nothing, or it is the material universe. It cannot be the material universe, for that has just begun; and if it be not that, it is nothing, and to talk of its evolution is absurd. But let us grant that it is the material universe. Well, if it be the evolution of the universe, whence is it evolved? From possibility, says Sir William; and whence is that? This is only an attempt to escape under the use of general terms. The meaning seems to be, that in the creation God put forth into action or actuality the power to create which he previously possessed the possibility of doing. This expresses a doctrine sufficiently correct, were it not for the accompanying assertion that God exercises this power by evolving the universe out of himself. Applying the phraseology to second causes, it would be said that the formation of a steam-engine "is the evolution of existence from possibility into actuality." In this case it is quite true that the man had previously the ability to make an engine, but out of what is the engine evolved? Out of the materials certainly, and not out of the man. Where, then, were the materials out of which God evolved the universe. They were no where. Therefore, in the work of creation, we cannot talk of the evolution of the created object. Were we to express what we hold to be our notion of creation, we would say that creation is conceived and is by us conceivable only *as the origin of existence* by the fiat of the Deity. We think *the fact* of the existence of the universe whenever it springs into being, but the *how* is beyond our reach. Let us again imagine the work of creation, and see what are the facts of consciousness. We imagine the universe beginning to exist; its existence is realized as a phenomenon. If, then, we are asked, *how* does it come into existence? we answer, that does not come within our observation, and is therefore beyond the range of our speculation. To attempt to answer, were to violate the first principle of sound philosophy. All that we can affirm is, that we now recognise the world springing into existence, and we think an operating power, the great first cause, as producing it. We think the universe as now existing, as a new existence, as an *increase in the sum of being*. It has nothing to do with this to tell us that we cannot think time previously existent and separate from the universe; that we cannot make time the object of thought, and think it before the universe began, as if this were essential to thinking the non-existence of the universe. When we are asked to think the time before a certain house was erected, we realize that time simply by thinking of events which occurred, or of objects which existed, before that house was built. And we also think the existence of power capable to combine and bring about the events and use the objects which existed prior to the act of building. So with the creation, we think the time when the world did not exist, by thinking God as alone existent. We have no more difficulty in thinking a time when the world did not exist, than in thinking a time when that house did not exist. If we think the world evolved out of God, it is plainly implied that we think God as previously existent. We, however, admit that we cannot understand how God operates without materials, for we have no such experience of causal energy ; but we think God as the cause which produces the effect, and we have no difficulty in thinking the object as beginning to exist. We at once recognise the absurdity of the assertion that God separated from himself a part of his essence, and so operated on it as to produce the universe ; and Sir William Hamilton recognises this when he speaks of the creation of the universe as its evolution from possibility into actuality. This is admitting that it did not previously exist, but that there was previously in God the power to produce it, which is a very different question from that involved in the assertion, that we think the act of creation by supposing that God evolves the universe out of himself.

The idea of distinct, independent power is thus admitted to be a necessary idea in the human mind, and as being more necessarily conceivable than either time or space. We have sought to determine what the nature of the power may be, and have been enabled to shew that power which is admitted to be is an omnipotent power. It is not a little remarkable that within the last few years opinions have been promulgated, with reference to the material world, by some modern writers, which resolve the creation into a system of dynamics, at the head of whom we may place Messrs. Grove and Radcliff, who, in theorising on the nature of the physical forces of the universe, have really attempted to resolve them into one force, and that force a dynamical idea of the essence of matter, as the ultimate essence into which we may resolve all things, which we presume is virtually, but not so intelligibly, asserting the existence of controuling power, as has been done by many philosophers. This opens to us for consideration the belief which minds even of a very opposite order discover, attributing to the material universe an innate possession of laws, which they think satisfactorily explain all the phenomena displayed, both by organic and inorganic bodies. Now we do not think that such belief can be refuted by an appeal to the special modifications and adaptations of the various isolated forms of which the universe is composed ; but we apprehend that a true article of faith may be clearly drawn up and proved, by setting forth the existence of a plan of creation governed by laws general and specialised, manifesting most distinctly the wisdom, power, and goodness which must dwell in a Cause capable of originating and carrying into action so comprehensive and perfect a scheme of creation. Professor Whewell, as long ago as the publication of the Bridgewater Treatises, acknowledged this to be the true principle on which to rest the argument for an intelligent cause; and very recently, Professor Agassiz insisted on the necessity of following up the method, observing, "That the argument for the existence of an intelligent Creator is generally drawn from the adaptations of means to ends, upon which the Bridgewater Treatises have been based. But this does not appear to me to cover the whole ground, for we can conceive that the natural action of objects on each other should result in a final fitness of the universe, and thus produce a harmonious whole. Nor does the argument, derived from the connexion of organs and functions, seem to be more satisfactory, for, beyond certain limits, it is not even true. We find organs without functions; as, for instance, the teeth of the whale, which never cut through the gums; the breast in all the males of the class of mammalia; these and similar organs are preserved in obedience to a certain uniformity of fundamental structure, true to the original formula of that division of animal life, even not essential to its mode of existence. The organ remains, not for the performance of a function, but with reference to a plan, and might almost remind us of what we often see in human structures, where, for instance, in architecture, the same external combinations are retained for the sake of symmetry and harmony of proportion, even when they have no practical object." We believe this reasoning to be true, and therefore resort to the more available proofs, which the existence of general laws affords.

In the first place, let me endeavour to exhibit the method which has been observed in creation. Attention has been directed to the existence of what may be termed "the law of generalisation." We believe that there is evidence sufficient to shew that the general plan, which is found to prevail in the structure of the organic world, applies with equal force to the inorganic, namely, "*the passage from the more general to the more special;*" there is such a general dependence of one thing on another, that we almost arbitrarily determine lines of demarcation, and it requires diligent enquiry to discover the existence of the law of independence, which it is admitted exists, in a world of mutual dependence.

If we interrogate geology as to what has been the condition of the earth in times past, the most convincing evidence is furnished of mighty changes accomplished, each one becoming more and more specialised by the addition of newer and more varied forms, adapted to peculiar conditions, so that while it may truly be said that each epoch was perfect in itself, nevertheless each succeeding one was rendered an advance on the former one, and exhibited special peculiarities, which lent to it particular characteristics. But where is the proof that all such arrangements are not the effect of chance? We can only appeal to common sense, to common experience, to reason, for the answer.

Mr. Crabbe, in his work on natural theology, following exactly the illustration selected by Dr. Crombie, asks, "If a person were to enter a room in which he saw no human being, but on a table were twelve of the twenty-four detached letters of the alphabet arranged in a straight line and in alphabetical order, and the other twelve in a confused heap by their side, he would probably stake all he possessed in the conviction that some one had placed those twelve letters in that orderly position, and that the other twelve had been cast down without any intention respecting their arrangement; and he would come to this conclusion, because in such cases it is a matter of invariable experience, that when mind does not interfere, no orderly sequence ever takes place except in the most limited degree." But how much more grand and conclusive an argument does the earth afford? If a sceptic, eager in search of truth, were to discover an illustrated book full of records, and between the leaves permanent facsimiles of the remains of an empire passed away, he would inevitably conclude from the many independent circumstances *necessary* to the existence or construction of such a work, that an intelligent mind had been engaged in its production; the wildest imagination could not for a moment be induced to accept as true the explanation which would attribute it to chance or a blind necessity. Here, then, we meet the sceptic on fair ground: such a book exists, prepared not by the hand of man, for many of its pages were written, and the mortal remains of the subjects of its history were entombed, volume after volume, shelved and carefully preserved, ere man walked this earth in "the image of his God." Interrogate these volumes, study the records of "the wreck of matter and the crash of worlds," and see if in each succeeding event we discover hopeless ruin and blind confusion, or learn of regeneration and progressive stages to more perfect states.

Geology henceforth becomes the handmaid to religion, and instead of aiding in the overthrow of inspired truth, furnishes the most convincing proofs in its favour. It teaches that before the Spirit of Life breathed on the earth and awaked the dreary silence which reposed on its granite bosom; that ere one lowly organism, which expressing the mystic union of life and matter, swarmed in its aqueous zones—time had passed away; that ever since the vapourous liquid nebula—the most probable condition of our parent earth in its earliest state—had first become consolidated, changes have been going on, Omnipotence constructing that skeleton frame-work, on which has been in succession formed the advancing orders of prolific creations. By what processes, or through what stages, has the mass assumed its solid shape?

Who may tell the time when gneiss and granite cooled to shut up within a hard and thickened crust the fiery and more centralised heat? But if in this beginning we have reached that time when life was not, so do we on this first page of our world's history soon learn that on its inorganic bed first was laid the deep foundations of a scheme which should, by progressive developement, unfold the unfathomable riches of its author's resources and fore-knowledge, and set forth the praise and glory of him who is the Alpha and Omega, the first and the last.

Hugh Miller, a name dear to every lover of that which is wise and good, the earnest, pious Hugh Miller, has drawn from the very observance of order and progression in nature, as displayed by the divine mind, an argument not only to prove the existence of a supeme creative intelligence, but even to deduce from a similar necessity in the human mind the essential nature of its relationship with that of its maker. And, observes Harris, "In an age in which a class of writers, not without their influence in the world of letters, would fain repudiate every argument derived from *design*, and denounce all who hold with Paley and Chalmers as anthropomorphists—that labour to create for themselves a god of their own type and form—it may not be altogether unprofitable to contemplate the wonderful parallelism which exists between the human and divine systems of classification." What was this order? Commencing, says Miller, at the bottom of the scale, we find the Thallogens, or flowerless plants, which lack proper stems and leaves ; a class which includes all the Algæ. Next succeed the Acrogens, or flowerless plants that possess both stems and leaves, such as the ferns and their allies. Next, omitting an inconspicuous class, represented by a few parasitical plants incapable of preservation as fossils, come the Endogens —monocotyledenous flowering plants, that include the palm, the libraceæ, and several other families, all characterised by the parallel venation of their leaves. Next, omitting another inconspicuous tribe, there follows a very important class, the Gymnogens, polycotyledonous trees, represented by the conifera and cycadaceæ. And last of all, come the Dycotyledonous Exogens, a class to which all our fruit, and what are known as our " forest trees," belong, with a vastly preponderating majority of the herbs and flowers that impart fertility and beauty to our gardens and meadows. Such is the arrangement of Lindley, or rather an arrangement the slow growth of ages, to which this distinguished botanist has given the last finishing touches. And let us now mark how closely it resembles the geologic arrangement, as developed in the successive stages of the earth's history.

(See diagram A, on succeeding page.)

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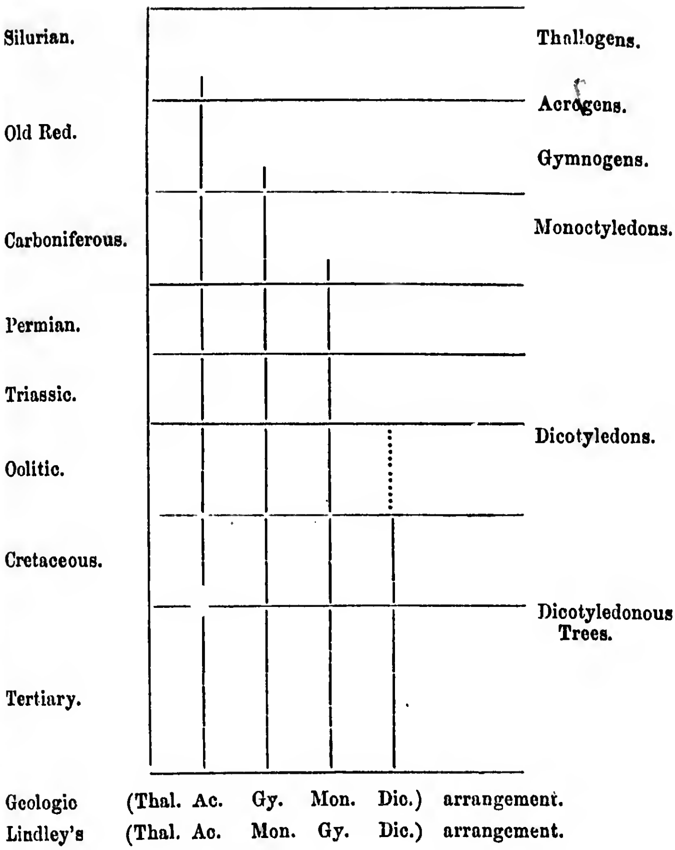
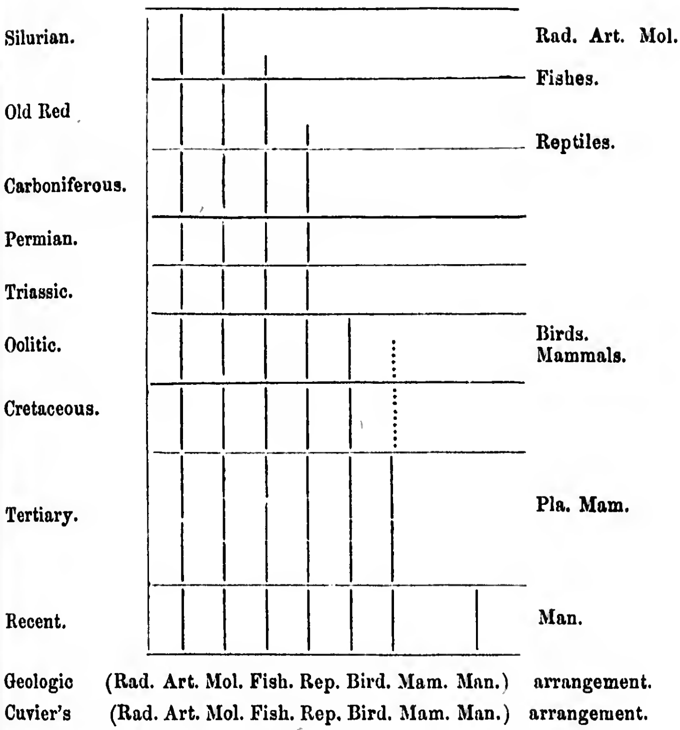
DIAGRAM A.



The parallelism which exists between the course of creation, as exhibited in the animal kingdom and the classification of the greatest zoologist of modern times, is perhaps still more remarkable. Cuvier divides all animals into vertebrate, and invertebrate; the invertebrates consisting, according to this arrangement, of three great divisions—mollusca, articulata, and radiata; and the vertebrates of four great classes—the mammals, the birds, the reptiles, and the fishes. From the lowest zone at which organic remains occur, up till the higher beds of the lower Silurian System, all the animal remains yet found belong to the invertebrate divisions. The numerous tables of stone which compose the leaves of this first and earliest of the geologic volumes correspond in their contents with that concluding volume of Cuvier's great work, in which he deals with the mollusca, articulata, and radiata; with, however, this difference, that the three great divisions, instead of occurring in a continuous series, are ranged like the terrestrial trees and herbs, in parallel columns. The chain of animal being on its first appearance is, if I may so express myself, a threefold chain—a fact nicely correspondent with the further fact, that we cannot in the present creation range *serially* as either higher or lower in the scale, at least two of these divisions—the mollusca and articulata.

(See diagram B, on succeeding page.)

DIAGRAM B.


Silurian.
Old Red
Carboniferous.
Permian.
Triassic.
Oolitic.
Cretaceous.
Tertiary.
Recent.
Rad. Art. Mol.
Fishes.
Reptiles.
Birds.
Mammals.
Pla. Mam.
Man.
Geologic (Rad. Art. Mol. Fish. Rep. Bird. Mam. Man.) arrangement.
Cuvier's (Rad. Art. Mol. Fish. Rep. Bird. Mam. Man.) arrangement.

Here we see the mind entirely engaged in the acquisition of knowledge, discovering systems of classification well nigh identical with those which ages ago have been engraved and recorded on stone; but when we carry out the comparison, how immeasurably does man's task fall below that which has been accomplished before. The latter has no doubt, by the exercise of the highest skill, and by the employment of deep reason, gradually succeeded in arranging in order the things of the world around him; not so with that other intelligence, which has not only "in the volume of the book in which are all our members written," exemplified things as they were, but also things as they must be hereafter. Can the sceptic impose upon himself a harder creed than that which he now endeavours to believe? Can he adduce solid arguments to prove that the impersonal deities which he creates—heat, light, electricity—all that may be included under the physical forces, or so-called forces of nature—are endowed with intelligence transcending far the brightest dreams of the power of intellect which the most intelligent of men can conceive. For even supposing that such intellectual forces existed, the mind cannot rest satisfied at this stage, but must seek yet another, in which they may discover some principle, some law, (!) some other presiding faculty, which has been entrusted with the task of harmonising and reducing to unity *independent powers* of such stupendous proportions as suffice not only for the creation of worlds in orderly progression, but capable of harmonising the several so-called creative forces.

Let us examine the doctrine of pantheism as stated by its authors, and endeavour to show the emptiness of its claims to be received as true. In a work which bears the stamp of genius on its pages, and received with no little applause by the scientific world, we find the author employing the following unmistakeable language in describing the effects of light and the influence of heat on organization: "An organized structure," says the distinguished Professor, "of a given kind is, therefore, the result of the operation of many of these forces, and is an expression of their aggregate action. In the full developement of a perfect tree there has been expended a measured quantity of forces, of light, or of heat, and the *organized mass* (the *italics* are our own) as it stands before us, the *product of those forces*, is the resultant of millions of vibrations of the luminiferous ether which have acted upon ponderable atoms; vibrations which have stood in a certain relation to each other, as the symmetry of the vegetable parts indicates." Again, in speaking of the effects of the sun on vegetation: "Where then do these things carry our reflections? What are the elevated ideas they bring before us? Do they not show that the great spaces of the universe are not simply solitudes, in which there only resides mechanical forces, in which only the influences of gravitation and projectile action occur? Do they not teach us that wherever a ray of light can pass, there is the capability for organization and life? And in those innumerable stars which we see at night; some of which are giving forth rays of one and some of another colour, and a multitude of double stars, which furnish complémentary lights to their attendant planets, who can tell what multiplied results these things impress on the world of organization? In our reflections on the constitution of the universe, though the beautiful perfection of its mechanism may excite our wonder, do not these views of its capability for organization, of the constant presence of light, THE PARENT OF LIFE, call for our unbounded admiration. Instead of regarding the interplanetary spaces as a great vacuum, a desolate solitude, they rise before us as regions filled with active forces, and ready to *put on and to communicate movement and life*." There is nothing equivocal in Professor Draper's language, light is apostrophized as "The Parent of Life," and, together with other "forces," is endowed with all the attributes of Deity; indeed the American professor's doctrine is rendered the more remarkable, and at the same time the more objectionable, since no one has stood forth a better champion of the independence of the respective forces than himself. Although ignoring Dr. Carpenter's revived Spinosism, that substance is the cause of its attributes, he falls into errors equally grave, and we cannot detect the slightest difference between Dr. Carpenter and M. Becquerel, whom Professor Draper directly quotes and objects to, saying, "No one can feel more strongly the absurdity of supposing that *nature* (?) has created between forty and fifty elementary ponderable substances, all possessed of metallic characters, and all so nearly alike that even a chemist is often puzzled to distinguish them from one another. No one, upon satisfactory proof, would more willingly go back to the alchemical doctrine in relation to these matters; but so long as the evidence on the constitution of these bodies rests where it does, the laws of chemistry compel us to admit them to be simple and undecompounded; and just in the same way that I am willing to admit the existence of forty different simple metals, so upon similar evidence I am free to admit the existence of fifty different imponderable agents, if need be. Is there any thing which would lead us to suppose that the imponderables are constituted by nature on a plan that is elaborately complex? *That the former are all modifications* of ONE primordial ether, and the latter intrinsically different bodies, more than a quarter of a hundred of which have been discovered during the present century? Whilst Professor Carpenter accepts but one force which is susceptible of assuming protean shapes, Mr. Draper fills the universe with independent powers, endowed or possessing supernatural intelligence and forethought. It is impossible for those who hold the doctrines which are so openly set forth, by modern writers, for any length of time to preserve their followers from extending their theories to a much more dangerous length than they themselves would desire: this has been the history of all false teaching; and where "forces" are called into existence and endowed with all the attributes of creative intelligence, it is not at all likely that the believers in such a creed will care to trouble themselves about a divine cause, nor will they recognise a personal omnipresent Deity. It requires but a very superficial acquaintance with the life of organised beings to discover, that in accordance with the complexity of their nature, so is their greater or less dependence on what are called external physical agents, and even in the life of the very first in the order of creation--man! we see enough to satisfy us that he is of the earth, earthy! But because this dependence is real, and acknowledged to be so, we are to be equally careful in setting forth the remainder of the history of organised beings, which as plainly testifies of their *dependence* on some great separate power, which has repeatedly interfered in their progress, and ever and anon introduced new forms and modified others, not in an irregular and confused manner, but always in strict accordance with the laws of order.

To this agreement Palæontologists* and Materialists have now come. "In the developement

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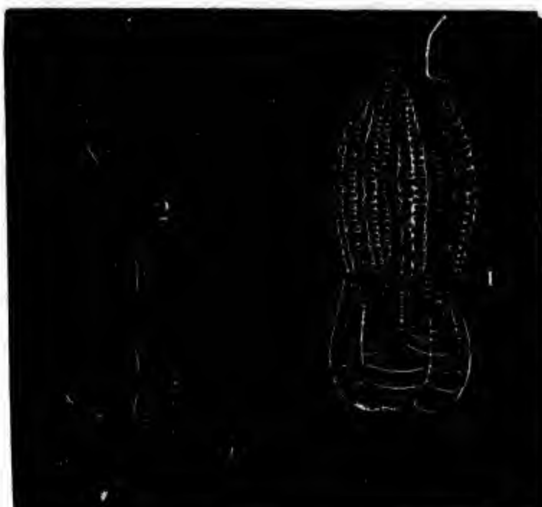
* παλαιος, ancient; οντα, beings; λογος, discourse.

of all living beings," to use the words of Von Bär, "*a heterogeneous or special structure arises out of one more homogeneous or general, and this by a gradual change.*" Dr. Carpenter, applying this law, observes, "It is peculiarly interesting to remark that the same general plan appears to have been followed in the organization of the vast series of living forms which have successively appeared on the face of the globe. The entombment of the remains of many of these, in the strata in progress of formation at the time of their existence, has enabled the Palæontologist to reconstruct to a certain extent the fauna and flora of each of those great epochs in the earth's history, *which are so distinctly marked out in geological time*, both by extensive disturbances in the earth's crust, and by striking changes in the structure and distribution of the living beings which dwelt upon it. *Each of these epochs* was characterised by some peculiar forms, or combinations of forms, of animal and vegetable life, which existed *in it alone;* and the further we go back from the existing period, the wider are the diversities which we meet with, both in that general aspect of these kingdoms of nature which depends upon the relative proportions of these different subordinate groups, and in the features and structure of the beings composing these groups. The attempt has been made to prove that these changes might be reduced to a law of progressive developement;" meaning, by this, that the lowest forms of vegetable and animal life were first introduced, that those of the least degree of elevation first presented themselves, and so on consecutively until we reach man, who, as the highest in the series, was the last to make his appearance on the globe. Further, it has been surmised that actual transmutation of the lower forms into the higher took place in the course of geological time; so that from the germs first introduced, or from others, which have since originated in combinations of inorganic matter, the whole succession of organic forms, from the simplest protophyte up to the oak or palm, from the protozoon up to man, has been gradually evolved; not, however, in single series, but from several distinct *stirpes*, whose developement has taken different directions. The facts of geological science, however, do not seem to bear out the first of these doctrines; and the facts of physiology lend no real support to the second. For it is easily capable of being shown, that although the doctrine of "progressive developement," as just stated, *may be true* in some of its main features, radiata, mollusca, and articulata having *perhaps* existed before any vertebrated animals left traces of their existence, fishes being abundant before we have any evidence from the remains of reptiles that any of the latter had been introduced, and reptiles having been for a time the sole air-breathing vertebrata, and having occupied the place (so to speak) of birds and mammals, when as yet these had been very scantily produced, or were altogether wanting, yet when we come to apply it more closely, it altogether fails; and if the doctrine of *progressive* developement in its usual form were true in every particular, it would afford no ground whatever for the doctrine of *transmutation*, which is not only opposed to all our experience, but fails to account for the intimate *nexus* that so commonly unites together, not merely the higher and the lower forms of each series, but the members of the different series with each other.

A more satisfactory account of the *successsion* of organic life on the surface of the globe may probably be found in the *general plan* which has been shown to prevail in the developement of the existing forms of organic structure, namely, the passage from the more general to the more special. Many indications present themselves that the types of each principal group first introduced were *not* the *lowest*, but that they presented *in combination* those characters which are found to be separately distributed, and more distinctly manifested among groups that subsequently made their appearance. One of the most curious exemplifications of this principle in the *radiated division of the animal kingdom, is to be found in the history of the class †*Echinodermata;* for the group which seems to have attained a high developement at the earliest period is not that of Crinoidea, by which the class in question is most closely connected with zoophytes, but that of *Cystidea*, which (there is reason to believe) was much superior to

* *Radius*, a ray. † εχινος, a hedge; δερμα, skin.

this in general organisation. Now this order seems to have presented a most extraordinary combination of the *most distinctive* characters of the remaining groups; of which some appear not to have existed, and the rest to have presented a very limited range of forms, at the time when it was predominant. Thus the Crinoidea of Palæozoic period, though very numerous, exhibit but little variety of type; and in the complete enclosure of the body by polygonal plates, they present a more close approximation to the Cystidea than do the *Crinoidea of the secondary



Crinoideæ—1. Apocrinus rotunda. 2. Encrinus maniliformis.

period, in which the variety of forms is much greater.

So again, the †Asteriada and Ophiurida of the ‡Palæozoic period appear to have represented only

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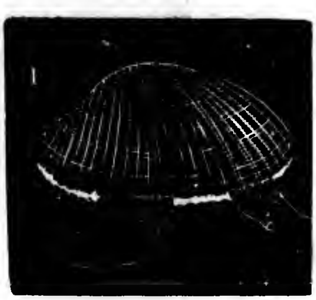
* κρινον, lily; ειδος, form. † αστηρ, star; ειδος, form.
‡ παλαιος, ancient; ζωη, life.
(*See Illustration, p.* 54.)

a small part of the forms which those groups have *included. It is probable that the true Echinida did not exist at all* in the Palæozoic period ; and although we are unfortunately not likely ever to obtain proof or disproof of the existence of Holithuriada, it cannot but be thought probable that they, too, *were as yet absent.* In the secondary period, on the other hand, when the *Cystidea had ceased to exist*, we have evidence that they *were replaced* by all the orders just named, (except Holithuriada, the softness of whose bodies would be likely to prevent their preservation) ; and these soon came to present a very high degree of developement, dividing among them (so to speak) the characters possessed by Cystidea, and carrying these out separately as the distinctive peculiarities of their respective structures. So among the higher *mollusca*, we find that a prominent place in the earlier formations was occupied by that group (Tetrabranchiata) which presents the last developement of the distinctive characters of the Cephalopod class, and which has so much in common with the testaceous *Gasteropods. Now there is no evidence

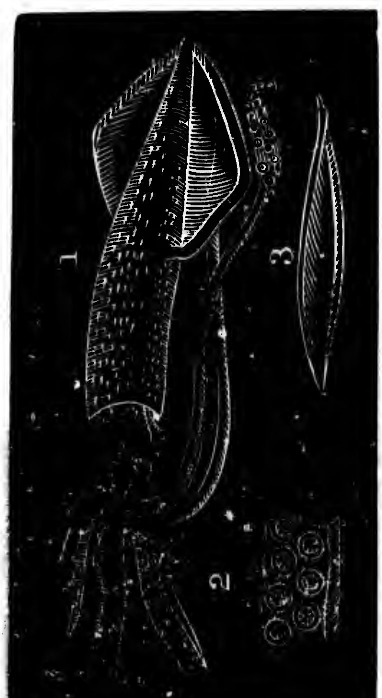
Gasteropod—Planorbis.



Mollusc—Cardium.

* γαστηρ, belly; πους, foot.

of the existence of the *higher* order of *"Dibranchiate" †Cephalopods, at that early date in the Palæozoic period at which the Tetrabranchiate order had acquired an extraordinary multiplication and variety of forms, and so far it might seem that we have a progression from the lower to the higher. But the paucity of remains of typical Gasteropods at the same period is almost as remarkable; and some of those forms which are most abundant (*e. g.* Enomphalus and Bellerophon) present indications of close proximity to Cephalopoda. So that it would seem as if the Nautiloid type is generally to be regarded as



1. Loligo, or Calimary—Cephalopod.
2. Suckers on side.
3. Rudimental shell, inner surface of mantle.

* κεφαλή, head; πους, foot. † δις, twice; βραγχια, gills.

having occupied the place at *that period* not merely of the order above, but also, in part, of the class below; its decline and almost complete disappearance, during the secondary epoch, being *coincident with* the multiplication of forms of the more typical Gasteropods and of the higher Cephalopods. Again, among the fishes which were the earliest of the vertebrated inhabitants of the globe, we find a remarkable assemblage of characters, some of them presenting, in the extraordinary developement of the dermo-skeleton, and in the softness and probably rudimentary condition of vertebral skeleton, an evident leaning to the invertebrata series; whilst others seem to have foreshadowed the class of reptiles, an approach to which is represented, not merely by the sharks and their *allies*, but by the Sauroid tribe of osseous fishes, which was extremely abundant towards the end of the Palæozoic period. The *Ctenoid and †Cycloid

Scales of fish—1. Placoid. 2. Ganoid. 3. Ctenoid. 4. Cycloid.

orders which, on review of the whole class, may be undoubtedly considered as comprehending the

* κτενις, a tooth, or κτεις, a comb. † κυκλος, a circle.

most *typical* fishes, did not make their appearance (so far as can be determined from the evidence of their fossil remains) until the *Cretaceous period. The universal possession of the *homocercal* tail, by the earlier fishes, is to be considered on *this view not* as an essentially embryonic character, but as the *most general* character of the class, which is presented in every member of it at an early stage of developement, but which subsequently gives place in certain cases to a *special modification.*

1. Heterocercal.
2, 3. Homocercal.

Turning to the air-breathing vertebrata, again, we find that during the secondary period, this series was chiefly represented by the class of reptiles which then attained its greatest importance, and included groups which represented fishes, birds, and mammals respectively, thus having *more general* character than the class at present exhibits. *These groups subsequently gave way* to the more *special* forms which carry out most exten-

* Chalk.

sively the reptilian type ; and when we look at the earliest forms of reptilian life of which we have any cognizance, we find them to present very remarkable combinations of the characters which are now distributed among different groups. Thus the Labyrinthodon of the Triassic formation, appears to have been essentially *Batrachian in its structure, but to have possessed some characters of the Crocodilian order. And the same formation contains the remains of reptiles, which, while essentially †*Saurian* in their general structure, had the horny mandibles, and probably many other characters of the ‡*Chelonia.* In the early history of the class Mammalia, so far as known to us, the same general plan may be traced. The only order that is still recognisable by the remains preserved in the secondary strata, is that of Marsupialia, which has much in common with the oviparous vertebrata. Near the commencement of the tertiary epoch remains of Pachydermata are abundant ; but these *were for the most part different* from those of the *present* epoch, containing combinations of characters which are now distributed among several distinct families, and presenting also a closer approximation to the Herbiverous Cetaceans on the one hand, and to the Ruminants on the other, than is exhibited by any existing species of the order. So among the early §Edentata, we

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* *βατραχος*, a frog. † *σαυρος*, lizard. ‡ *χελωνη*, a turtle.
§ *Ex*, without; *dens*, tooth.

Comatula—Crinoid.
No. 1—Early life.
No. 2—Detached and free.

meet with a group, now entirely extinct, which connected that order with the massive Pachyderma.

Now the most that Professor Draper and his followers can claim for their deities, will not account for the method and orderly arrangement which the recorded history of the past unfolds. All the light and heat of billions of centuries would not suffice to originate the life of the smallest atom of the cell-wall of the humblest organism; then much less are these forces or agents of themselves sufficient to explain the mysterious nature of the law of type, or why such a law is *in the nature* of beings. Does the action of light and heat on living beings in any way explain to us why, at any one time, an animal like the Toxodon should exist? An animal referable to the order *Pachydermata, intimately related to the Rodent order, and with manifest affinities to the Herbiverous †Cetaceous order. Or, again, Marauchenia

* κητος, a whale. † παχυς, thick; δερμα, skin.

Patagonica, a large extinct mammiferous animal, referrable to the order pachydermata, but with affinities to the ruminantia, and especially to the camelidæ; in short, are we enabled to trace any connexion whatsoever between these important and necessary agents, and the *special form* of organised beings? In the very important, although lengthy, extract from Dr. Carpenter, which so plainly sets forth the *fact* of *progressive* and more *special* creations, *new* forms are introduced on the stage, not by *developement* out of one form into another, but by the creation of a special form, having centred in itself the special peculiarities which existed in combination with those of a more general character in some older form, as in the two instances cited above. The law of specialization, or differentiation, as it is sometimes called, is certainly not one of the least significant of those which are observed to be in duration in the universe; and it is only because we have confined its jurisdiction to the organism or material fabric, that we lose sight of its real importance—believing that to be only real which is evident to the senses, we have failed to appreciate the equally real existence of things which is manifested only in their action: hence the "differentiation of life," as well as body, is a fact not grasped by our minds. Physiologists have ceased to regard any one agent as the cause of action in organised beings; and even in the same organism we discover that while each part has a life of its own, and influences the other parts with which it is associated, so that "the foot cannot say to the hand 'I have no need of thee,'" yet, as in the case of muscle, the power to contract is inherent, and is the manifestation of the power of peculiar life in muscle, although the degree and time of contraction are regulated by another system; so in the whole body, its various actions are but so many manifestations of its general life. We would ask the law worshipper to inform us how "light!—the fountain of life impulsions, the great centre of vital dynamics"—directs and controls the law of type? Nay, we presume that we may go a step further, and ask, how has the sun given the law of type? Where are the proofs? Verily observation contradicts this declaration, and clearly points to other equally important conditions which exercise as much influence, and which are as *essential* to organisation, as light and heat. The law of differentiation of *life* and *body* is most mysterious and astounding, and is one which has not received that close attention from the natural theologian which it so well deserves. In the study of the operations of this law, we cannot fail to discover its co-working with those other laws which so effectually influence the phenomena of life on this globe.

In the differentiation, which is so clearly manifest in the various typical forms bestowed on organised beings, we cannot separate the organic base from its vital force or life—the two are conjoined and constitute "the living being," the single animal or vegetable form; and in proportion to the differentiation of this organism, *i. e.*, its greater complexity and power of self-dependence, is its independence of those external circumstances which surround it. This is not only true of the kingdom of organised beings as a whole, but it is equally true of the individual parts of which each being in that kingdom is composed—each separate cell of which the animal or vegetable is compounded having a life of its own, and in accordance with that life and its destined office, is it dependent on external circumstances. To this we shall refer more particularly shortly. The anatomist hoped that when he should be enabled to expose the ultimate structure of organised bodies, that he would at least stand on the threshold and gaze on the mystery of life; and Schwan's doctrine of "cell developement" for a time seemed to sanction the statement, that every being proceeds from a cell, the cell being the form of life.

Subsequent observation has fully proved the fallacy of Schwan and Schleiden's views. The labours of scientific anatomists and physiologists reveal to us a class of "organised bodies," which have in no part of their lives passed through the process of cell-growth or developement; and instead of looking on the simple cell, as it is called, as the necessary form or basis of life, we are compelled to view it as one of the first steps in differentiation—

the foreshadowing of complexity in organisation, which so constantly presents itself. It is in studying the history of the simple cell, that we discern the full force of Dr. Williams's remark, that "there is some mysterious relation between the *shape* and the substance, between the *material* and the *form.*" So far, however, from "life" being manifested only in organisms that are compounded of different parts, we find the original declaration of Hunter to be strictly true; for every individual particle of animal matter is possessed of life, and the least imaginable part that we can separate is as much alive as the whole." The attempt to revive, on a more rational basis, the dynamical theory of force, first promulgated by Leibnitz, proves that there is an innate necessity to trace all things to a cause, and then to discover the nature or fitness of the cause for the accomplishment of the act. Let us ascertain the views which Leibnitz held, and then contrast them with those of the present school, and learn if possible how far we may gather the testimony for the existence of independent power or force. "A thousand phenomena," Leibnitz declares, "are passing around us—a perpetual series of movements and developements take place, and how are we to account for all these? Extension alone does not explain them; there must be some other fundamental attribute of substance, from which these phenomena take their rise. In fact, unless we choose to admit that every movement in nature is the direct product of the Divine Mind, we must *attribute* to all substance an *inherent power*, by which the phenomena of *motion* are generated. But, then, where does this inherent power reside? It cannot reside in masses, *as such*, for essential attribute is independent of all such combinations. Masses are infinitely divisible; the limit to which even material substance tends, as far as extension is concerned, is zero. Every material property, properly so called, vanishes; *and we come at last* to the simple and immaterial idea *of power*, as the essential basis of all existence. The simple idea of force, Leibnitz terms *a monad*, and consequently, instead of an atomic theory of the universe, we have a system of monadology based *on the fundamental conception of dynamics.* The monad being indivisible, unextended, immaterial, cannot be exposed to any influences from without; being indissoluble, it can never perish. Nevertheless, in all monads changes *do* perpetually take place, of which we are perfectly cognisant, and for which we must assign some sufficient cause. The cause, then, not being external, must be internal; *that is, all monads must contain an inward energy, by virtue of which they develope themselves spontaneously.* Without discussing at present the correctness or incorrectness of this doctrine, we shall proceed to show how it has been introduced into the modern school, divested even of some of those least objectionable points peculiar to Leibnitz. Mr. Mill and Professor Carpenter are its two great supporters, and from them we may gather a very clear exposition of the doctrines originally delivered by the renowned philosopher from whom they have borrowed much. Dr. Carpenter, in his justly celebrated work on Human Physiology, asks, "What is the original source of that organising force, which the cell receives during the early stage of its developement, and which it subsequently exerts upon the nutrient matter it appropriates, and to this question it seems possible now to give a more satisfactory answer than that with which physiologists were obliged to satisfy themselves. For it was maintained by some, that the germ of every living being contains *within itself the whole of the force necessary* to accomplish the organisation of its fabric, and to impart to each portion of it the peculiar powers with which it is endowed: an obvious objection to this doctrine is, that if this be true, not only must the germ contain the whole vital force of the fabric *into which* it is evolved, but also that which it imparts to its descendants (?); so that the first individual of a race must have concentrated within itself the vital force of its entire posterity —a palpable *reductio ad absurdum.* To escape from this difficulty it has been alleged that the vital force with which matter becomes endowed by the process of organisation, previously existed in it in a *latent* form or *dormant state*, and is made *sensible* when the nutrient matter is incorporated into a living fabric.

"This doctrine could claim no higher value than that of a mere hypothesis, and it rested on the idea that latent or dormant force of other kinds had a real existence—an idea of which a more logical appreciation of the facts of science has completely exposed the fallacy. For it is now coming to be generally acknowledged, that all force must (from its very nature) be *active* in some mode or other; that force can nei[illegible]riginate *de novo*, nor *cease to be operative* un[illegible] form; and that in every case in which forc[illegible]o be annihilated, it merely changes its *modus operandi*. Thus, when motion is retarded by friction, heat is generated, with *electricity* in addition, whenever the rubbing surfaces are otherwise than perfectly homogeneous; so, when it is caused to vapourise water, it no longer manifests itself as heat, but in the form of mechanical power, which produces *motion:* and the discharge, which restores the electric equilibrium, is in like manner attended with the developement of the mechanical force. It will be found that in all instances in which such a conversion or metamorphosis of force takes place, some MATERIAL SUBSTRATUM is required as its instrument. This may be, in some cases, of almost any description whatever; as when heat is produced by the friction (or retarded motion) of solids, or liquids, or even of gases; or when motion (as shewn in expansion) is produced by the application of heat to any kind of material substance. But in other cases the change can only be effected

through some *special* kind of instrument; or if several substances may serve as its medium, then in some one which is greatly superior to every other, in the readiness with which a certain force manifests itself through it. Thus, iron is the substance through which an electric current can best develope magnetic force; a combination of bismuth and antimony is that through which heat can best generate electricity; and the affection of light by magnetism, though producible through any transparent medium, (but not through a vacuum,) can be made much more obvious when magnetism is made to act upon a glass composed of vitrified borate of lead, than through the medium of any other substance yet known. It is, indeed, on this speciality in the action of different substances, when subjected to the influences of the same forces, that our notion of their properties entirely rests; and to say that all matter which is capable of becoming organised, possesses "vital properties," is merely to affirm, in other words, that it is capable of *being made* a part of a *living* structure, and of becoming the instrument of operating, after the same fashion, upon other matter—leaving the question as to the source or origin of the force which thus changes it, or by which it induces changes in other matter, just where it was. Looking at the phenomena of life from the same point of view as that from which we are now taught to regard those of the physical sciences, viz., as the results or manifestations of a certain kind of force acting through those forms of matter which we term organised,—we are further led to seek for its source, NOT *in the organism itself*, but in some *power external* to it. And this power we find in those physical agencies, light, heat, and electricity, *which have* been commonly accounted "Vital Stimuli;" their operation, singly or in combination, having long been recognised as necessary to enable an organised structure to manifest vital phenomena. Thus, light, acting upon the living vegetable cell, makes it the instrument of decomposing carbonic acid, water, and ammonia, and of generating organic compounds, which the chemist has not yet been able to imitate; and the amount of carbonic acid thus decomposed has been found to bear a constant ratio (*cæteris paribus*) to the illuminating power of the rays which it receives. The agency of light, however, is chiefly exerted in preparing the pabulum to be appropriated by the organism; and we see in the germinating seed, that when this has been previously elaborated, light is not required for its conversion into living tissue; but for this purpose a certain measure of heat is required; and the rate of germination, *i. e.*, the rate at which the organisable material is converted into living tissue, is determined (within certain limits) by the degree in which that agent is in operation. In the animal kingdom, for which, as for the germinating seed, the nutrient material is already provided *by a pre-existing vegetation*, the dynamical influence of light is of comparatively little importance ; but we have abundant evidence in the life of the "cold-blooded tribes," which are destitute of the power of maintaining an independent temperature, that the rate of vital activity, as manifested both in the phenomena of growth and developement, and in the production of nervo-muscular force, is determined (within certain limits) by the amount of *heat* to which the individual is subjected. This dependence is no less real and immediate in the case of warm-blooded animals ; but it is rendered less apparent by the uniformity of temperature which they are enabled to sustain. Of the degree in which the ordinary phenomena of life are dependent on electricity acting upon the organism from *without*, we as yet know next to nothing ; the mode in which they are affected by *this agent* not having been yet precisely determined. It can scarcely be doubted, however, from wha [illegible] known, that it stands in very close relation to vital force, and is capable of exerting an extremely powerful influence upon its operations. It seems, then, to be a legitimate expression of the dynamical conditions requisite for the production of the phenomena which we distinguish as *vital*, to say that they are dependent, directly or indirectly, upon the physical forces pervading the universe ; *which acting through* ORGANISED STRUCTURE *as their material substratum*, *manifest themselves as vital force*—one of the most characteristic operations of this being the *production* of new tissue, which *in its turn* may become the instrument of a similar metamorphosis. And we have the same kind of evidence that light and heat, acting upon the organic germ, *become transformed into vital force*, which we possess of the conversion of heat *into* electricity (?) by acting on a certain combination of metals; or of electricity into magnetism, by being passed round a bar of iron; or of heat or of electricity into motion, when their repulsive action separates the particles of matter from each other. For just as heat, light, electricity, chemical affinity, &c., are transformable into vital force, so is vital force capable of manifesting itself in the production of light, heat, electricity, chemical affinity, or mechanical motion: thus completing the proof of that mutual relationship, or co-relation, which has been shewn to exist among the physical and chemical forces themselves.

It is extremely difficult to understand Professor Carpenter's actual meaning from the statement above quoted; and indeed, after an examination into his writings as a whole, we cannot, at this moment, clearly discover what his precise views are: we know not whether it is intended to establish the doctrine that there is but *one* form of force which is modified by passing through a particular substratum, or whether there are several forms or kinds of force which display certain phenomena according to the base on which, or with which, they are acting. Dr. Williams, of Swansea, thinks that the learned and laborious author of the system of physiology intends to teach "that 'vital action,' cell growth, nerve force, and muscular action, *are the* physical imponderable forces modified in manifestation by passage through an organic material substratum — heat becoming vital force by passing from without into the egg. Such expressions imply the locomotion of an entity." It is almost impossible to avoid arriving at any other conclusion; and if Professor Carpenter's doctrine be legitimately carried out, and should his system be accepted, it must lead to the most unfortunate results. In the first place, we must not allow *theory* to stand in the place of truth, and until it is proved that there is but *one* force to which has been delegated authority, endowed with a decidedly super-natural intelligence, we must be excused if we refuse to accept a doctrine as established which is based simply on assumption. Professor Agassiz, in reasoning on this very question, observes: "I have known those who hold it to be very unscientific to believe that thinking is not something inherent in matter, and that there is an essential difference between inorganic and living and thinking beings. I shall not be prevented by any such pretensions of a false philosophy from expressing my conviction that as long as it cannot be shewn that matter or physical forces actually do reason, I shall consider any manifestation of thought as evidence of the existence of a thinking being as the author of such thought, and shall look upon an intelligent and intelligible connexion between the facts of nature as direct proof of the existence of a thinking God, as certainly as man exhibits the power of thinking when he recognises their mutual relations. I am well aware that even the most eminent investigators consider the task of science at an end as soon as the most general relations of natural phenomena have been ascertained. To many the enquiry into the primitive cause of their existence seems either beyond the reach of man, or as belonging rather to philosophy than to physics. To these the name of God appears out of place in a scientific work, *as if the knowledge of secondary agencies constituted alone a worthy subject for their investigations*, and as if nature could teach nothing about its Author. Many, again, no doubt are prevented from expressing their conviction that the world was called into existence and is regulated by an Intelligent God, either by the fear of being supposed to shew clerical or sectarian prejudices, or because it may be dangerous for them to discuss such questions without at the same time acknowledging the obligation of taking the Old Testament as the standard by which the validity of their results is to be measured."

In order to prove the untenable nature of the views propounded, we shall now endeavour to point out the manifest inconsistency in the physiological canon. Professor Carpenter observes, "that the doctrine that the germ of every living being contains *within itself* the whole of *the* force necessary to accomplish the organisation of its fabric, and to impart to each portion of it the peculiar powers with which it is endowed, is a palpable *reductio ad absurdum*." As we hold this doctrine on good authority, we feel disinclined to yield it up for any other until we have been or can be satisfied that that other is the true one; for in the Sacred Record it is declared that, "God said, let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit *after its kind*, *whose seed* is in itself, upon the earth: and it was so." Again, we have the remarkable expressions contained in the blessing of Jacob: "And God appeared unto Jacob, * * and said unto him, Thy name *is* Jacob: thy name shall not be called any more Jacob, but Israel shall be thy name * * be fruitful and multiply; a nation and a company of nations shall be *of thee*, and kings shall come out of thy loins." "The land which I gave Abraham and Isaac, to thee will I give it, and *to thy seed* after thee will I give the land." The same is declared by St. Paul, who says, "Verily they that are of the sons of Levi who receive the office of the priesthood have a commandment to take tithes of the people according to the law, that is, of their brethren, though they come out of the loins of Abraham. * * Levi, also, who receiveth tithes, payed tithes in Abraham, for he was yet in the loins of his father when Abraham met him."

What, then, the physiologist considers an absurd theory, we hold to be the only rational doctrine, and that it is the only scheme by which we may explain family relationship, likeness, peculiarity, &c. In the next place, we are glad to avail ourselves of the argument as stated, as it seems well to bring out the proofs of those points on which we are now more immediately engaged, and establishes, not only that there must be a cause or power, but we arrive a step further, and gain the admission of a power which is efficient and capable of acting according to a well devised plan. We, in the first place, object to this physiological argument, because it starts with an assumption, and not only supposes a relationship between the various forces, but actually takes as proved the existence of but *one force*, which is modified by the substratum through which it passes; whereas we have no right to suppose the forces of physical bodies any thing but the affections of matter. Now no one the least conversant with the phenomena of creation can for a moment fail to recognise the intimate connexion between mind and matter, or rather between life and matter, for "the Lord God," as it is said, "formed man out of the dust of the ground:" at his command the earth was let to bring forth the living creature after his kind, and grass and herb and the fruit tree;" and to preserve these latter more especially, and to point out their dependence and connexion with the world around them, "there went up a mist from the earth, and watered the whole face of the ground;" and to the animal kingdom was given "every herb bearing seed which is upon the face of the earth, and every tree in which is the fruit of the tree yielding seed to you it shall be for meat." Again, what can more strongly point out the intimate dependence of created beings on the world of which they form a part than the conditional promise which was given: "If ye walk in my statutes, and keep my commandments, and do them, then will I give you rain in due season; and the land shall yield her increase, and the trees of the field shall yield their fruit * * ye shall eat your bread to the fill." Again: "Ye mountains of Gilboa *let there be no dew*, neither *let there be any rain* upon you, nor fields of offering." In that most sublime dedication of the temple to God uttered by the mouth of wisdom we are taught to implore that "When heaven is shut up, and there is no rain, because they have sinned against thee: if they pray toward this place, and confess thy name, and turn from their sin, then hear them in heaven and forgive the sin." And why? Because all flesh would perish.

Surely these are no equivocal expressions? Boldly and unhesitatingly man is taught to remember whereof he is made, and to humble his haughty thoughts by the recollection that as man he is of the earth. Did, however, the Magna-charter of the human race stop here we should be of all creatures the most miserable; but fortunately neither it nor the illustrated book of nature finish at this point, for both proclaim a higher destiny, as well as a loftier status, to man.

Before, however, we seek out the true relationship which exists between the organic and inorganic kingdoms, and the physical forces of the universe, it may be well to enquire whether there is any certainty of the doctrine of a single force, independent of matter, or capable of entering into and passing from matter to matter; and, next, what is the true meaning of the term, correllation of force. The author who first brought forward in a systematic form the phenomena of living beings as correlated to physical forces, was the distinguished Tuscan, Professor Matteuci, although the celebrated John Hunter and Milne Edwards had both specially directed experimental researches towards the subject, and established many important truths.

"Living beings," says Matteuci, "are endowed with the general properties of all natural bodies" (that is, with the general properties of all others in addition to their own special endowments, for a distinction of primary importance is to be kept in view, viz., they are living beings). The most ultra-vitalist never dreamed of denying that *living* organised matter is extended, impenetrable, devisable, and porous. How can we believe that caloric, electricity, light and chemical affinity, act on these beings in a manner entirely different from that which they are known to do on the other bodies of nature. Are we to conclude that all the phenomena of living beings are explicable, by the general properties which belong to them *in common* with all the bodies of nature, and by the sole action of the great physical forces, caloric, light, electricity, and attraction? Such an inference would be as far from the truth as the conclusion of those who have denied, and still deny, these general properties to living beings, and who regard them as entirely beyond the influence of physical agents. Who could confound an organised being with an inorganic body? The groups of closed vesicles of different dimensions, united and disposed in an irregular manner, then is assuredly *some thing* essentially different from a mass of polyhedral particles, composing a crystal. To say, with some micrographers, that organisation is crystalisation effected in a liquid, which the first formed crystals imbibe, is equivalent to admitting that the structure of a stalactite is identical with that of the lungs or liver. Molecules of at least three elements, into which a great number of elementary atoms enter, must necessarily form chemical systems, whose affinities differ from those which are possessed by molecules chiefly composed of two elements, and in which the number of elementary atoms is smaller. And if the general chemical actions, by showing us that combinations become weaker in proportion as the number of elementary atoms increase, are sufficient to explain the tendency of organic bodies to resolve themselves into more simple combinations; if chemistry furnishes us with many instances of this same tendency in some inorganic compounds whose composition has many analogies with that of organic bodies, it is not therefore to be inferred that the laws of inorganic chemistry are sufficient to give us a complete explanation of all the chemical phenomena of life. We must then conclude that organisation and the molecular structure of living beings effect important modifications in the action of chemical and physical agents. Open an animal, examine its kidneys and its liver, and then ask yourselves by what physical force you can explain how the blood, which is carried to an organ, forms bile and urine. We conclude, therefore,—

1st. That living beings have the general properties of all the bodies of nature: that these properties are influential in the production of the phenomena proper to them; and that, consequently, we must not neglect or disregard them when we attempt to explain these phenomena.

2nd. That the great physical agents, caloric, light, electricity, and molecular attraction, act on living beings as well as on all the bodies of nature, and that this action must necessarily be influential in the production of the functions peculiar to these beings.

3rd. *That these forces*, when acting on *organised* matter, sometimes have *their* general mode of action modified, and that this difference is owing to a diversity in the structure and chemical composition of organised bodies.

4th. That there are also in living beings phenomena which we call vital: that these are numerous and of the highest importance, and that in the present state of the science, we are unable to explain how their production can be influenced by physical agents, though the action of these be modified by the organisation.

According to Matteuci, then, the affections of matter are various, and the combinations of matter also various. We have no reason to believe that certain forms of matter could exist in combination without being acted on by an innate principle which dwells in the united whole. The constituent inorganic elements of a plant or animal need the superadded principle of life. An organised body implies a compound arrangement of elements, and that the elements may be varied indefinitely.

Professor Draper, of New York, in his admirable work, observes in the examination of the theory of M. Becquerel, and on the detithonizing action of yellow solutions: "I have some years ago brought forward the doctrine, that we are compelled to enlarge our catalogue of imponderable principles: that there is nothing unphilosophical in supposing that an invisible principle should exist in solar light is shown by the analogy of radiant heat, a principle equally invisible to our eyes, but of which the existence is palpable enough to our other organs of sense. In a dark room we are utterly unable to see a vessel of hot water, but its calorific emenations are plain to the hand, even at a considerable distance. In like manner this analogy is supported by the recent discovery of Becquerel. For a long time it has been known that there are certain bodies, such as calcined oyster-shells, which shine in darkness after a brief exposure to the light. A hundred years ago it was discovered that the transient light of an electric spark is sufficient to awaken the dormant glow of these bodies. Now Becquerel has shown that to the rays which thus issue from an electric spark and cause this wonderful phenomena, *glass is opaque*—that light can pass through glass but the phosphorescent rays cannot: they also are invisible to the eye. There are certain phenomena which may be explained on the supposition that the invisible tithonic rays escape by radiation from bodies which have been impressed by them, those bodies simultaneously reverting to their original condition. * * Dark invisible rays thus exist in sunlight, and carry on a variety of functions, and control a variety of phenomena. Of solar principles, four different kinds have been traced : rays of light, of heat, tithonic, and phosphorescent rays. *What are the latter two?* We must include these tithonic rays. Before admitting the hypothesis of M. Becquerel, that the agent under consideration is one and indivisible, and that all the phenomena we discover are due to the receiving surfaces, and that there are as many spectra as there are substances in nature, each giving its own manifestations when exposed to the sun's ray, we should make enquiries like the following: how is it that a piece of black cloth exposed to the moonbeams does not become warm? How is it that a cannister of hot water is not luminous to the eye? In the rays that come from the moon and those that are admitted by warm water, is there no intrinsic difference, or does the phenomena depend on the receiving surface alone? What becomes of the beautiful experiments of Melloni, on the physical independence of light and heat, since they are mainly founded on the fact, that by the use of absorbent media we can separate one from the other? How is it that the rays of an electric spark passing through quartz can make the Bolognian stone phosphoresce, but passing through glass equally transparent and equally colourless, can do no such thing? The receiving surface is the same in both cases; and, as far as human eye-sight can discover, the light that comes through the glass is as pure and unaltered as the light that came through the quartz, but the results are diametrically opposed. And is it not more consonant to reason to suppose that the glass was opaque [illegible] impervious to some agent existing in that beam, which freely passed the quartz—opaque to it, but transparent both to it and the tithonic rays. We are thus forced to admit that rays of light, rays of heat, tithonic rays, phosphoric rays, and probably many other radiant forms, have an *independent* existence, and that they can be separated by proper processes from each other. Light itself can produce as many different effects as there are possible combinations of colour, for each one of its rays has peculiar powers of its own; and it is also attended by other invisible and imponderable principles which have their modes of action." Here then we discover reasons for inferring that one at least of the so called physical forces is itself constituted of other forces, capable of producing various results: in other words, we learn that the matter in space which gives rise to light is not homogeneous, but itself compound, as declared by the compound phenomena to which it gives rise; and as every part of a ray of light has its specific office, we cannot avoid the inference, that the matter of which each separate part is composed is in a peculiar state, or is really diverse. We apprehend, however, that specific independence may be proved of all the physical forces, and that Dr. Carpenter's illustration of the transmutation of force is not correct. We have already pointed out that by correlation he understands *convertibility*. Is this true? Now the argument, it will be noticed, is thus put, taking the case of heat as the most familiar one: "When heat is caused to vapourise water, it no longer manifests itself *as* heat, but in the form of mechanical power which produces motion." In this statement it is implied that heat is changed into motion; there is a *conversion* of force: it is not said that these respective forces, as affections of matter, are related to each other; that there is a similarity in their respective modes of manifestation and action, but that there is identity of essence.

Now to this doctrine there are many serious objections: first, as to the question of fact, that "heat in the vaporisation of water *is changed* into motion." It is essential, in the case given, that a certain amount of heat be present, or rather that the particles of matter should be so affected as to cause them to manifest a definite amount of heat before the phenomena of vaporisation are displayed. How can it be said that the one force or affection is changed into the other; on the contrary, the two affections coexist, the one necessitates (under the necessary conditions) the presence of the other: some of the atoms of water will assume the motor condition, others will continue to discover heat. Water at 212°, ordinary pressure, boils; at 210° it does not; at the former increment of heat there is rapid movement, at the latter there is not: diminish the temperature, and there is diminished motion, or cessation of movement.

It is interesting sometimes, as well as instructive, to trace back the origin of doctrines; and in this instance it is remarkable to discover the modern theory of the correlation of force unmistakeably declared in the Timœus of Plato: "Let us investigate the nature and affections of fire and water, air and earth, prior to the generations of the heavens; for up to the present time, no one has unfolded their generation: and yet we speak of fire and other things as principles and elements of the universe, just as if the elements of each were known; whereas at the same time the best intelligence must be aware that they cannot be compared even to letters or parts of which syllables are formed. In the first place, then, what we now denominate water, on becoming understood, seems to take the form of stones and earth, and when melted and dispersed, that of vapour and air; air also, when burnt up, becomes fire; while the latter again, on becoming again condensed and extinct, resumes the form of air; and again, air, when collected and condensed, produces mists and clouds, from which, when still more compressed, rain descends; and from water again are formed earth and stones: the whole of them, as it seems, exchanging all round their natural generation. As these, then, never maintain any constancy of existence, who will have the assurance to maintain that any one of them is *this* rather than that? No one; and it would seem by far the safest plan to speak about them as follows: when we see any thing constantly passing from one state of existence to another; as, for instance, we should not say, that it was fire absolutely, but some thing fiery; and, again, that what we call water is not so absolutely, but something watery, without assigning to them any names that would give the idea of stability, as we think people do, when they express it by *this* or *that;* for, not being of an abiding nature, it cannot endure to have applied to it such terms as, this, *this thing*, of this nature, *belonging to this*, and any such others as would show it to have a substantive existence. Hence we should not give any one an individual name, but call it some thing such-like, *i. e.*, wholly such-like, and similarly likewise every thing endued with generation. [That receptacle] however in which each of these appears successively to grow up and decay, that alone is entited to be termed *this* and *that;* whereas any thing of any kind soever, as *hot*, white, or their contraries, and all therefrom proceeding, cannot be so denominated. Let us again try more clearly to explain our meaning. If any one, in modelling all kinds of figures out of gold, were unceasingly *to transform them one by one into all the others*, and some one present were to point to one of them and enquire what it was, it would be far the safest and most correct to say that it was gold ; but as for its being a triangle, or any other figure that was given to it, not to speak of them as being so in reality, inasmuch as they are in process of change even while we make such assertion, but to be content if it be denominated such-like (or of such a nature). The same remark applies to that which receives all bodies ; and we should ever call it by the same name, as it never abandons its own proper power, but perpetually receives all things, and never any where or in any way assumes any of those shapes that enter into it—being in fact a natural receptacle for every thing, receiving both motion and form from what enter therein ; and this is why it exhibits a different aspect at different times."

Now if we compare the above with Mr. Grove's views, as published in his very excellent work, it must, we apprehend, be apparent that the doctrine of correlatiou is by no means new ; but Mr. Grove's views are not to be confounded with those of Professor Carpenter. In speaking particularly of light, he observes that, "In a lecture delivered in January, 1842, I stated that it appeared to me more consistent with known facts to regard light as resulting from a vibration of the molecules of matter itself, and not from a specific ether pervading it ; just as sound is propagated by the vibration of wood, or as waves by water. I am not here speaking of the character of the vibrations of light, sound, or water, which are very different from each other, but am only comparing them so far as they illustrate the propagation of force by *motion in the matter itself.* The fact itself of the correlation of the different modes of force is, to my mind, a very cogent argument in favour of their being affections of the same matter; and though electricity, magnetism, and heat, may be viewed as produced by undulations of the same ether as that by means of which light is supposed to be produced, yet this offers greater difficulties with regard to the other affections than with regard to light: thus conduction and non-conduction are not explained by it; the transmission of electricity through long wires in preference to the air which surrounds them, and which must be at least equally pervaded by the ether, is irreconcilable with such an hypothesis. The phenomena of these forces affords, as I think, equally strong evidence with those of light, of ordinary matter acting from particle to particle, and having no action at a distance. The experiments of Faraday on electric induction, showing it to be an action of contiguous particles, are strongly in favour of this view.

"One of the objections to which this view is open is the necessity involved in it of an universal plenum; *for if light, heat, and electricity*, &c., be affections of ordinary matter, then matter must be supposed to be every where where these phenomena are apparent, and consequently there can be no vacuum. The answer appears to me to be, first, that we have no proof of a vacuum ever having been formed. The Torricellian vacuum, the most perfect with which we are acquainted, is filled with the vapour of mercury. Davy's experiments on this point prove, at all events, the formation of a vacuum to have been, up to this time, impracticable. Secondly, the other two theories equally suppose the non-existence of a vacuum: according to the emission or corpuscular theory, the vacuum is filled by the matter itself, of light, heat, &c.; according to the etherial, it is filled by the all penetrating ether.

"Of the existence of matter in the interplanetary spaces we have some evidence in the diminished periods of comets; and where, from its highly attenuated state, we cannot test the character of the medium by which the forces are conveyed, we may, if we please, call this medium *ether*. Our assumption is, that wherever light, heat, &c., exists, ordinary matter exists, though it may be so attenuated that we cannot recognise it by the tests of other forces, such as gravitation. On the other hand, a specific matter, without weight, must be assumed, (?) of the existence of which there is no evidence but in the phenomena for the explanation of which its existence is supposed. To account for the phenomena, the ether is assumed; and to prove the existence of the ether, the phenomena are cited. For these reasons the assumption of the universality of ordinary matter is the least gratuitous."

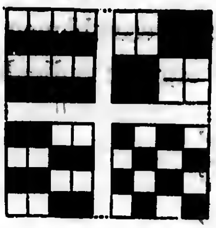
Professor Williams, of Swansea, supports, in the main, Mr. Grove's opinion. Here, then, is simply a re-enunciation of the old Platonic doctrine of the transmutability of matter, and the correlation of the forces or affections of matter; for, as Williams observes, "The transmutability of matter (Dumas, Faraday,) is no longer held as an alchemic extravaganza. The facts of allatropism, established by the genius of Schonbein, and the late prophetic speculations of M. Dumas on the chemical, electrical, and mathematical *progression* traceable through the properties of isomeric or conformable bodies, awaken in the mind of the modern chemist a reverence for the disentombed manes of alchemy. The transmutable bodies group themselves in nature in triads, or ternary series, thus: chlorine, bromine, and iodine; sulphur, silenium, and tellurium; calcium, strontium and barium; lithium, sodium and potassium. The members of these triads severally are capable of replacing one another in chemical compounds. When these bodies, having qualities precisely similar, though *not identical*, are arranged in succession of their chemical powers, there will be also a successive arrangement of mathematical powers, indicated by the respective atomic numbers of the substances, and amenable to every mathematical law. That this symmetry of chemical with mathematical function points to the possibility of transmutation is unquestionable, yet not transmutation in the sense of the old alchemical philosophy. Chemists see no manifestations of being able to convert lead into silver, or silver into gold. These metals are not chemically conformable ; one cannot take place of another by substitution ; they do not form an isomeric group. The preceding illustrations are drawn from *inorganic* bodies. Chemists have long believed that certain organic compounds display in their properties a close resemblance to metals : of this kind are the three organic radicals—

$$C_2 \quad H_3 \quad O$$
$$C_4 \quad H_5 \quad O$$
$$C_6 \quad H_7 \quad O$$

which may be regarded as the three several axiodes of an isomeric triad, bearing analogy to those already adverted to in the inorganic world. With reference to these radicals (omitting the oxygen) it is found, as in the case of the inorganic triads, that the sum of the atomic weights of the extreme bodies divided by two is equal to that of the intermediate body.

The discovery of allotropism has bereft these speculations of impossible extravagance. The allotropic modifications of which sulphur, phosphorus, oxygen, and carbon are susceptible, suggest the thought that the countless array of organic compounds which now bewilder the chemist, may prove *only modified* *forms of one unchanging radical.* Like those of isomerism, the phenomena of allotropism inspire the zoochemist with new hopes. Solidified albumen and fibrine are allotropic conditions of liquid albumen and fibrine. *Physically* the former differ remarkably from the latter, chemically they are identical.

"In the isomeric compounds, that is, in such as possess the same composition, but not the same properties, a different arrangement of the atoms is to be supposed; in the same manner as in a chess-board, where the white and black squares may be grouped together, either 2 and 2, or 3 and 3, or 4 and 4, &c. This variety in the grouping of the atoms, which happens only as an exception among inorganic substances, occurs as a general rule among organic compounds; and it has here so much the larger scope, because always three or four, and sometimes even more elements, are present, which enter into combination with each other, while, in the department of inorganic chemistry, commonly only two elements unite with each other; and likewise because it is a law in organic chemistry, *that the atoms of the elements do not unite singly, as is the case with mineral substances, but always in groups; namely*, 2, 3, 4, 6, 8, 10, *or more atoms of one element, with any number of atoms of the other elements.*



"Organic substances have, therefore, an incomparably *more complicated constitution* than the inorganic compounds, as the following examples show :

1 2 3 4 5

"From the well known amber, a peculiar acid, *succinic* acid, is obtained, which consists of four atoms of carbon, two atoms of hydrogen, and three atoms of oxygen, and has accordingly the formula $C_4 H_2 O_3$ (see No. 1). If one atom of oxygen is added to this, we have the constitution of *malic acid* $= C_4 H_2 O_4$ (see No. 2). If one more atom of oxygen is added, that of *tartaric acid* $= C_4 H_2 O_5$ (see No. 3). And by adding yet another atom of oxygen, that of *formic acid* $= C_4 H_2 O_6$ (see No. 4). But, on the other hand, if one atom of hydrogen is added to the succinic acid, which was the starting point, the constitution of *acetic acid* is obtained $= C_4 H_3 O_3$, &c. (see No. 5). If we are not yet able to produce all the transformations as they are here given, yet the possibility of succeeding at some future time cannot be doubted."—(Stockhardt). "There was a time when the doctrine which supposed the convertability of metals was opposed to known analogies; it is now no longer opposed to them, but only some stages beyond their present developement."—(Faraday).

According, then, to these views matter and force are correlates in the strictest sense of the word. The conception of the existence of the one involves the conception of the existence of the other. The quantity of matter again, and the degree of force, involve conceptions of space and time. The doctrine of the correlation of matter, as above set forth, we can understand, inasmuch as the unity of matter, and its phenomena, are presented to us on a generalized plan of creation; but the views of the learned British physiologist are so contradictory that we believe it to be impossible to reconcile them. The essential point of difference between Messrs. Grove and Carpenter we hold to be this, that whereas the former recognises matter as endowed with phenomena and *special forms*, and not to be productive, but rather "capable of manifesting special power or powers," the latter evidently considers the physical forces as so many real forms or entities which exist as products of, and essentially flowing from, matter; or, to use their author's words, fashioned by the material substratum.

To show the fallacy of the theory, it will be necessary to bring into contrast different statements put forward. In human physiology we are taught "that we have evidence of the operation of *a power* in the human body, whose manifestations are so different from those of any of the physical forces, that we cannot reasonably refrain from giving it a distinctive designation ; and *that this vital power may exert itself in a great variety of modes*, and may consequently *produce* a great variety of phenomena, according to the material conditions of its operation, just as (though the comparison be somewhat clumsy) the mechanical power which turns the engine shaft in an extensive factory is rendered efficient for an immense variety of purposes, according to the construction and arrangement of the several machines through which it is distributed. And further, that *the source* of this vital power is to be found, not in the organisation of the being itself, but *in the forces which operate on it ab externo ;* and that it has the same close affinity."

There can be no doubt as to what is here meant by correlation ; and it is equally clear that the term is not used in the sense as when employed by Mr. Grove ; on the contrary, according to Dr. Carpenter, physical forces are external entities, which acting on matter, are *transformed* into each other, and are acted on by the material substratum into which they enter. Every material substratum, therefore, according to this view, must have, as part of its essence, a *conversion of force power :* a doctrine far more absurd than that on which its author has passed condemnation, since abundant proof will be furnished to show that the organic substratum is itself controlled and influenced by some innate in-dwelling power even in it, as an elementary germ. Already we find Professor Draper declaring that "the existence of the vital force of physiologists—as a homogeneous and separate force—is uniformly denied," for he says: "The progress of science shows plainly that living structures, far from being the product of one such homogeneous power, are rather the resultants of the action of a multitude of natural forces: gravity, co-hesion, elasticity, the agency of the imponderables, and all other powers which operate both on masses and atoms, are called into action; and hence it is that the very evolution of a living form *depends on the condition* that all these various agents conspire. There is no mystery in animated beings which time will not at last reveal. It is astonishing that in our day the ancient system which excludes all connexion with natural philosophy and chemistry, and depends on the *fictitious aid of a visionary force*, should continue to exist." This is certainly not so, for no one denies the influence of external circumstances, although they may maintain the reality of life.

All this is from the pen of one who stoutly defends the doctrine of the independence of the physical forces, so called; but in the case of organisation denies the independence and reality of the vital principle; yet Professor Draper declares, with reference to light, "That there is nothing unphilosophical in supposing that an invisible principle—as tithonic rays—should exist in solar light, as is shown by the analogy of radiant heat: a principle equally invisible to our eyes, but of which the existence is palpable enough to our other organs of sense." Although it is in the highest degree unphilosophical to acknowledge the independence of a principle which evidently does exist, albeit in combination. We surely must not necessarily refuse to admit that organic beings may include in their organisms affections that exist in inorganic matter, besides superadded ones, since it is in full accordance with the law of differentiation. Again he adds, "*Organised* structure of a given kind is the result of the operation of many of these forces, and is the expression of their aggregate action. In the full developement of the perfect tree there has been expended a measured quantity of forces, of light, or of heat; and the organised mass as it stands before us, the product of those forces, *is the resultant* of millions of vibrations *of the luminiferous ether* which have acted upon ponderable atoms; vibrations which have stood in a certain relation to each other, as the symmetry of the vegetable parts indicates." And hence, as a further developement of the doctrine, we find another chemist thus discoursing of light: "The luminous principle which emanates from stars, placed at the profoundest distance in space, affects the eye—is related to optical mechanism of the animal—its nervous tissue and circulating blood, in precisely the same manner as the light of our sun. Luminous impulses which expend themselves on the retina in a few minutes after they have left the central orb of our system, affect the brain in exactly the same way as those which have been as many thousands of years travelling from the uttermost bounds of the telescopic universe. If, therefore, our sun, the great centre of *vital dynamics* and *fountain of life impulsions*, which has charge of the destiny of our planet—alike its atoms and its masses—be but a solitary star among the countless hosts of the celestial spheres; if the earth be a scene of life, beauty, and intelligence, only by virtue of its astronomical relations; if the messenger of God, the SOLAR BEAM, comes through the spacious amplitudes a hundred millions of miles, to illuminate, and vivify, and people *our otherwise desolate globe;* if the life exciting forces traverse stellar distances, and belong to astral systems, can we imagine, even for a moment, that the phenomena of life are limited to our earth? Can there be a question that organisation is the product *of a plan of agencies* which comprehends the physical universe, and that the effect must be as universal as the cause?"

Directly opposed to such sentiments are those promulgated on the authority of Professor Draper, in his work on Physiology; and except that we detect the idea of the localisation of the soul, or life of man, we cannot imagine a more forcible enunciation of the complete independence of life. Professor Draper says: "I have constantly assumed the existence of an intellectual principle, spirit, or soul, whose *links* of connexion with the external world are the *sensory* ganglia and *cerebral* hemispheres. We may profitably enquire whether any arguments in behalf of the existence of such an agent may be gathered from anatomical and physiological facts, or whether we must assume it as a postulate, relying for proof on evidences of a totally different character to those which are presented by the science in question. It is to be greatly regretted that evidence drawn from structural arrangement has hitherto, by very high authority, either been totally cast aside, or held in very light esteem. It is still more deeply to be regretted that those who should have known better have conceded the argument, that from no consideration, based upon anatomical or structural arrangement, could proof be obtained of the existence of an immaterial principle. But what if it should turn out that, from the study of the cerebral mechanism, distinct proof can be obtained on this point—proof of just as cogent a nature in support of the doctrine of the existence of the soul as that which we have of the existence of the external world, and of precisely the same character. We may present it as follows: The simple cellated nervous arc consists essentially of these portions, a centripetal fibre, a vesicle, and a centrifugal fibre: the centripetal fibre may have, at its outward or receiving extremity, vesecular or cellular material. Thus constituted this mechanism is ready to receive external impressions, which, if such language may be appropriately used, are converted or reflected in part by the ganglion into motions, and the residue retained. But the arc, viewed by itself, is a mere instrument, ready, it is true, for action, but possessing no interior power of its own. It is as automatic as any mechanical contrivance in which, before a motion can be made, a certain spring must be touched.

The essential condition of such a nervous arc is therefore the presence and influence of an external agent—a something which can communicate the primitive impression, for without it the mechanism can display no kind of result. Moreover, there must be adaptation between the nature of that agent and the structure thus brought into action with it, as is strikingly illustrated by each of the organs of sense. Thus the peripheral extremities of the fibrils of the optic nerve are involved in a combination of a purely physical kind, having relation to the properties of light: the convex surface of the cornea, the unequi-curved lens, the diaphragmatic iris, the interior investiture of black pigment; these are all structures we clearly understand. We know that the rays of light must undergo refraction at the curved surfaces upon which they are incident, and depict the images of external forms on the retina, or black pigment, the iris expanding or contracting, as the case may be, to regulate the entrance of the light. So completely do we admit this principle of an adaptation of structure to the nature of the agent which is to set it in activity, that in this particular instance, without any hesitation, we class the eye among optical instruments. But in the same manner that starting from the well known properties of light, we advance to the explanation of the uses of the various parts of the eye, there can be no doubt that the converse of this method of reasoning would be possible to an intellect of sufficient power, who, from a full consideration of the structure of the eye, might determine the properties of light, guided in doing this by the principle that there must be an adaptation between such structures and such properties; and in the same manner a man born deaf and dumb, but of an intellect of great capacity, might doubtless, from a critical study of the construction of the ear, determine the nature of sounds. Nay, even more, it is not impossible that he should be able to compare together the physical peculiarity of the movements which constitute light or sound respectively, and to demonstrate that these originate in normal, and those in transverse vibrations. These problems present themselves under a double aspect, and are capable both of direct and inverse solutions: given the nature of light, to determine what must necessarily be the structure of the organ of vision; or, given the construction of the eye, to determine what is the nature of light; and the same of the organ of hearing.

This inverse method of treating natural agents is still in its infancy, because of the extreme imperfection of our knowledge; but what has been said may perhaps recal to the mind of the reader the parallel example which is furnished by astronomy, and which, within a few years past, has yielded such a splendid result. The mass of a planet being known, the perturbations which it can cause in another are capable of direct computation; but it was reserved for Leverrier to discuss the inverse problem, and from the perturbations to find the planet. Now the problem we are dealing with is of this kind. It may be thus stated: given the structure of the cerebrum, to determine the nature of the agent that sets it in action. And herein the fact which chiefly guides us is the absolute analogy in construction between the elementary arrangement of the cerebrum and any other nervous arc. In it we plainly recognise the centripetal and centrifugal fibres, and their conveyance to the sensory ganglia, the corpus striatum and optic thalamus: we notice the vesicular material at their external periphery as presented in the convolutions of the human brain (see wood cut, comparison of brains,); and if in other nervous arcs the structure is merely automatic, and can display no phenomena of itself, but requires the influence of an external agent; if the optical apparatus be inert and without value, save under the influence of light; if the auditory apparatus yields no result, save under the impression of sound: since there is between these structures, and the elementary structure of the cerebrum, a perfect analogy, we are entitled to come to the same conclusions in this instance as in those, and asserting the absolute inertness of the cerebral structure in itself, to impute the phenomena it displays to *an agent as perfectly* external to the body, and as independent of it as are light and sound; and that agent is the soul. Thus it may be proved that those actions which we term intellectual do not spring from mere matter alone, nor are they functions of mere material combinations; for though it is indisputably true that the mind seems to grow with the bodily structure, and declines with it, exhibiting the full perfection of its powers at the period of bodily maturity, it may be demonstrated that all this arises from the *increase*, *perfection*, and *diminution* of the instrument through which it is working. An accomplished artisan cannot display his power through an imperfect tool; nor if the tool should be broken, or become useless through impairment, is it any proof that the artisan has ceased to exist; and so though we admit that there is a correspondence between the developement of the mind and the growth of the body, we deny that it follows that, either the mind did not pre-exist, or that the death of the body implies its annihilation.

Agreeing fully in the arguments, we are at a loss to conceive why they have been restricted to the mental operations of man ; and, indeed, when so restricted they are stript of much of their force. We believe that the evidence is equally competent to prove the independence of the *whole* life of the organism—as a distinct principle—and that the differentiation of the various organisms can be explained in no other way than that they are evidence of "adaptation of structure" to the nature of the agent which is to set it in activity. May we ask, What of the embryo before the cerebrum is formed fully? Is not the life there? Is there not that specialised life-power which determines the future destiny of the germ—an existing principle?

We regret very much not having as yet been able to obtain a copy of Professor Goodsir's able lecture "on organisation," lately delivered in Edinburgh, but from the short review which we have seen, he has nobly vindicated the truth. "The chief feature," says the review, "in the lecture was, where the professor alluded to the idealism and materialism theories which had been common in Germany, but which had never attained any degree of popularity in England. He said, in considering physical powers, they must not omit psychological ones : that organic powers were developed from within outwardly; that a psyche existed in animals and plants, and that man, besides possessing *a psyche*, possessed a *pneuma*, an ESSENCE PECULIAR TO HIMSELF. Thus by his *psyche* he could bring himself to the level of the brute; and by his *pneuma* he could raise himself to the higher and more noble position which he occupies; and thus living organisation was a system of psychycal and physical powers."

CHAPTER II.

Man, as a reasoning being, may attain to a knowledge of the existence of immortal life and of a Supreme Being, by the exercise of that faculty of mind which he alone, of all earth-born creatures, possesses, viz., "reason;" by employing this gift and special faculty on the visible works of nature around him, by the exercise of his reason in dissecting the myriad forms of matter by an analysis of matter itself, and yet more by the existence of a moral law and craving for truth, he becomes conscious of the existence of a self-determining power which is capable of leading to higher results, anon the necessary existence of a self-existing Supreme Power, at once the fountain and origin of all that is manifest. Prof. Hickock, in his "Rational Cosmology," speaks clearly when he says, "We have a position from which we see that all labour is useless unless we turn to the use of the reason solely to discover the absolute reason, the faculty for direct and immediate insight. That we have such a faculty distinctive in kind, and giving to us all our prerogatives of rationality, personality, and free and responsible originality, is sufficiently clear in the consciousness of its own working. In pure diagrams we see universal truths, without any process of logical deductions, as that, any three points in space must be in one and the same plane; and that any two sides of a triangle must, together, be greater than a third side. In pure physics we see that action and re-action must be opposite and equal; and that compound forces must give their conjoint direction to motion. In pure forms we can see spiritual sentiment, and thus have an ultimate standard of taste in the beautiful; and in spirit itself we can see an intrinsic excellence that demands for itself that it should be an end, and thus have an ultimate standard of right in the good. We will apply this rational insight to a series of grounds, in which may be detected the working of other than material forces; and also to the distinctions in an ascending spiritual spontaniety up to the supernatural; and in the spiritual we will detect also the point which separates the conditioned from the unconditioned, and come directly upon the Absolute and Divine.

Let it be remarked that the Absolute we seek is not excluded from all relations and conditions. That which should be without all relations and conditions, that which should be utterly without relations, would not be expressed, and that which should be utterly without conditions, could not be explained. It is only necessary that the relations and conditions should be wholly subjective, *self-directed*, and self-sustained, and bringing with them no dependence upon, nor ameniability to, any outer being. Not without self-relations and self-conditions, but wholly absolved from all dependent relationship and subjected conditioning to any other. A grain of wheat may be wrapped up in the same cerements together with an Egyptian mummy—thousands of years pass away, and not a moment in the long period has been without action neither in the living wheat nor in the dead mummy. But to the insight of reason, a broad distinction is seen between these perpetuated activities. In the dead, all the agency has been from without, and coming upon the subject that has been modified and changed by it; while in the living, the agency has been its own, springing up ever fresh within it, and resisting the outer agencies that would corrupt and dissolve it. The one has been the mechanical attrition of material forces, the other has been the spontaneous spring of a living energy. We seize upon this vital energizing as reason gives it to us, and reserve it for our purpose in our future progress.

The living energy can only act according to conditions imposed upon it. It cannot germinate and propagate itself in new grains without the air, the sunshine, and the moisture. It is a power put into matter, but only according to conditions imposed upon it, and when these conditions are supplied, it is still conditioned within itself, and must grow out after its own controlling, "first the blade, then the ear, afterwards the full corn in the ear," and this full corn in the ear only, "the seed after its kind." With all the spontaniety of life, the vegetable is still bound in matter, and even its life *is conditioned* by an imposed law which it can by no means transcend; and thus its whole being is in and of nature only.

The ox that treads out and eats the grain has all this living energy, with the very remarkable addition that it can feel itself and give back sensation for sensation. Through the power of sensation it can be impelled to locomotion, direct itself in the selection of its food, and guide its experience by rules of prudence. The insight of reason finds at once in this a higher grade of spontaneous energizing, and knows that here is an approach towards self-direction. The animal can condition itself by its own sensations. We take then this higher idea of spontaniety which reason has gained in animal life, and hold it for our purpose.

But this animal life and sensation are also in matter, and subjected to all the conditions of matter. Its very sentient life, which distinguishes it from the vegetable, is active only through matter. It uses and seeks the material only, so that if we speak here at all of the spiritual being, it is of "the spirit of a beast which goeth downward." Its feelings are all determined for it in the laws imposed upon it; and the sentient life can *neither assume* nor *propagate* other laws of energizing than those of its own kind. The animal is yet, therefore, wholly in nature.

Man has, besides the sentient animal life, the far higher endowment of a rational existence. The peculiarities of his rational being are in the following distinctive elements: he can originate for himself what to him are the perfect ideal patterns or archytypes of that which is the beautiful, the true, and the good, and use them to measure, criticize, and estimate all that experience may offer. Not what is taken from experience, but what his own genius creates for him, is his criterion for testing what he shall approve and what disapprove. He has his own principles or standards of judgment within himself, and with which the material and sentient world has nothing to do. He has also that self-knowledge which determines the intrinsic excellency of this his rational being, and what is due to himself and worthy of himself in all his actions. He can thus feel the claims of self-respect and responsibility to his own conscience, and know the retributions of self-approbation or self-reproach according as his deeds sustain or violate the law which his own rational being imposes upon himself. Here are peculiar self-relations and self-conditions, all subsisting within the rational, and having no dependence upon his animal being. The rational activity to guide and determine itself alone, both without and even against the animal life. Although we have elsewhere referred to the differentiation of life—higher grades of spontaneous energizing—as a law in creation; we cannot refrain from shewing the entire independence of life by illustrations which are excellent and forcible. A recent writer, in pointing out the consequences which follow the "confounding the action of the *organs* with the results that follow," remarks, "Prof. Berard says, that penetrated with the idea of a special organ being necessary for respiration, he experienced a singular disappointment in reading the experiments of Spallanzani, which proved that every tissue of the body absorbed oxygen and gave out carbonic acid; and he only recovered his contentment on perceiving that *the essence of* respiration consisted in this interchange of gases, so that, wherever a nutritive fluid was in contact with the atmosphere, respiration must take place." Prof. Berard was right in conceiving that a special organ was necessary for respiration, and his error arose from confounding the action of the organ with the result of that action. Respiration effects the interchange of gases, and the æration of the blood by means of a peculiar organic apparatus, without which the due æration would not take place in the higher animals. In the simpler animals this apparatus is not needed, because the nutritive fluid being easily accessible, requires no function to bring it into contact with the air; but no sooner does the organism become so complex that a direct æration of the nutritive fluid ceases to be possible, than an apparatus is constructed, the functions of which are to effect this æration. The same holds good with sensation, as recently put forth by a very ablewriter. "What we metaphorically call nervous conduction, takes place not only in the absence of fibres, but also in the absence of nerves whatever. The fact is demonstrable, that both contractility and sensibility are manifested by animals totally destitute of either muscles or nerves. Some physiologists, indeed, misled by *a priori* tendency to construct the organism in lieu of observing it, speak of the muscles and nerves of the simplest animals; because, when they see the phenomena of contractility and sensibility, they are unable to dispossess themselves of the idea that these must be due to muscles and nerves. Thus, when the fresh-water polype is seen capturing, struggling with, and finally swallowing a worm, yet refusing to swallow a bit of thread, we cannot deny that it manifests both sensibility and contractility, unless we deny these properties to other animals. Nevertheless, the highest powers of the best microscope fail to detect the slightest trace of either muscle or nerve in the polype. To call the contractile substance a "muscle," is to outrage language more than if a wheelbarrow were spoken of as a railway carriage; and as to nerve substance, nothing resembling it is discernible. In presence of these facts, those who cannot conceive sensibility without a nervous system, but are forced to confess that such a system is undiscoverable, assume that it exists "in a diffused state." It is a flat contradiction in terms; a diffused nerve is tantamount to a diffused crystal. Whence then is the sensibility derived? Either we must admit the presence of what cannot be discovered, or we must admit that a function can act without its organ; or finally, we must modify our conception of the relation between sensibility and the nervous system. Which of these three conclusions shall we adopt? Not the first; for to admit the presence of an organ which cannot be discovered, even by the highest powers, although easily discoverable in other animals, would be permissible only as the last resource of hypothesis, when no other supposition could be tenable. Not the second; for philosophic biology rejects the idea of a function being independent of its organ, since the function is the activity of an organ. The organ is the agent, the function the act. The third conclusion therefore seems inevitable: we must modify our views. Instead of saying, "Sensibility is a property of nervous tissue," we must say, "*Sensibility is a property of the vital organism which becomes* SPECIALISED *in the nervous tissue in proportion as the organ itself becomes* SPECIALISED." We have no difficulty in understanding how contractility, at first the property of the whole of the simple organism, becomes *specialised* in muscular tissue. We have no difficulty in understanding how respiration, at first affected by the whole surface of the simple organism, becomes *specialised* in a particular part of that surface—gills or lungs—in the more complex organisms: nor should we have more difficulty in understanding how sensibility, from being common to the whole organism, is handed over to a special structure, which then performs that function exclusively, as the lungs perform that of respiration, or the muscle that of contraction. Nay, more, just as animals possessing special organs for respiration, do also, in a minor degree, respire by the general surface, so it is almost demonstrable that animals, possessing a special nervous system, also manifest sensibility in parts removed far from any nervous filament. In man we find an organism fitted for the performance of the highest functions—the material substratum adapted to the manifestations of faculties which transcend those of all creatures co-temporaneous with him, and in the possession of the gift of Reason, leading him up to association with beings which, in the same orderly differentiation, stand as it were between him and the Supreme. The organism is subordinate to, or is the instrument of, the ME; for the beautiful, the true, and the right are in the Reason itself, and instead of copying them from nature and experience, it judges both nature and experience by them. It can move itself not only without the promptings of sentient nature, but directly against and over them. All of nature may be on one side, and yet the rational can say I ought and will stand and act on the other side. It can make its own conscious worth and dignity its end of action, and exclude all other ends which nature may present, from holding any competition with this. Here is a real spontaneity, related in its activity and in its law, its going forth and the end it is to reach, only to itself. It furnishes its own end and occasion for its activity. It is self-activity self-directed. From the existence of this power in man, we see how it is that he is made in the "image of the Supreme," and endowed with an "immortality, a real essence, a principle, incarnate in matter," by which he is enabled to imitate the great Archytype of himself. Man, it is quite true, cannot originate matter—he cannot put forth any *new* forces—yet, in a lower sense, man is a creative being, conceiving ideas to which he gives form by employing crude matter in their construction, and compelling, as it were, the dumb stones to speak his mind. Who, that has bent his head in worship and humbled his soul before his God in His thrice-hallowed Church, can fail to admit that there proceeds from those holy piles an impulse—an incentive to holy thoughts; he feels that in the carcases of stone and wood the mind of man has developed, into form and fair proportions, that which calls up vigorous sentiments in him and his fellow man, of piety and love. Do not the monuments of antiquity give back to this present age the wonderful history of nations passed away, even to the records of their daily life? Is there nothing of creation in all this mind?

To give force to these arguments, we may add the reasoning of Herbart—that *me* is really an essence, it is not self-consciousness! Knowledge—no matter whether it bear reference to ourselves or to other things—is only a certain state, an activity. But such cannot be conceived without some being which is in that state, or which is the author of that activity. So much, then, seems to be evident; the *me* must, in itself, be something real. Add to this, that no man will look upon himself as being merely an activity, to wit, of something else; on the contrary, if there is any thing at all which is immediately certain to us--if there is any thing that is affirmed in and not with us, it is beyond doubt this, that there is, at the foundation of our personality, one *single* essence which is itself self-subsistent, and remains always the same in itself in all the states through which it may pass.

The *me*, to which every one refers as being himself, is, in the first instance, our person, and implies every thing which belongs immediately to our body and our spirit. But it is not that *personal me* of which we are now speaking, and which, if it were to be fully and sufficiently indicated, would require a long series of predecates—an auto-description and auto-biography. We refer here rather to what is termed the *pure* or the *absolute* me, at which we arrive at last, after having in thought eliminated every thing which is only the state of our *soul.* That me, which thus designates itself, is found in the inmost depths of our own self-consciousness. It refers not only to the body, but also to all the sensations, representations, wishes—in short, to all our activity, as to something that belongs to it, that is in connexion with it, that proceeds from *it:* from *it* we say, as from the innermost and invariable central point of the essence—the connecting point of all thinking and doing. But this me does not only represent itself to the outer world, but also its own self. If it puts the question to itself what itself is, the answer is returned: I am that essence which represents to myself both the world and my own self. The me represents itself; it has or forms an image of itself. Hence the essential characteristic of the me is self-consciousness, it does not discover any other within itself; it cognises itself, and knows about itself only as about self-consciousness.

The free spontaneity, self-activity, which we discover, is the conception of spirit as opposed to matter—that which is contrary to matter, yet which, being bound and tied up in matter, reveals itself in as many *personalities* or individualities, as there are associated material forms in *humanity*, reaching its highest development—the visible revealing the invisible. If in the conception of force as the essence of matter, we approach that border line which separates matter from spirit, we but do that which the Absolute Power has done, and which reason approves, viz., reached that point where distinct forces meet and result in objective existence; for reason unfolds to us not *one* force working in nature as subordinate to another, but One Supreme Force, All-Powerful, Absolute Existence, originating and creating forces which are objectivised, manifested in forms. Thus there may be a relationship between the several forces as there is in the several forms of matter, and yet by the reason the understanding is corrected in its judgments, and it can be conceived that in the combination of forces is the origination of a new thing, even a distinct personality. It is, we apprehend, after this manner that we may admit a correlation between spirit and matter which does not involve the notion of identity, and leads to a conception of the reality of spiritual existence superior to, and differentiated from, matter, and yet which may be involved in or combined with matter as a special form or mode of existence. It is from this point of view that we are informed of the distinctibility of matter, *even under its present mode of existence;* for although forces may and do change their modes of manifestation indefinitely, yet, after Cousin, we can conceive of the utter annihilation of matter by a suspension of the free-will of that All-Absolute Power which alone cannot cease to be Free Spontaneity, the Absolute under self-contained conditions. The same reason guides the judgment correctly, and informs it how spiritual existence must be in its forms differentiated, even to the highest, and that there is in the mode of existence of spiritual essence a significance as important and real as there is in material forms.

What is matter? asks Prof. Hickock. The first answer comes from the sense. The conception as gained in experience—the earliest, the easiest, and thus the common conception of matter, is that of some dead, dry, hard substance, given in mass of larger or smaller volume. It is found divisible into parts, and we readily conceive that the largest bodies may be made up of small particles, and in our analysis of these particles, we bring them into atoms which will not admit that we should further subdivide them. We thus begin with that into which we have analysed our experience, and conceive of matter as originally existent indivisible atoms, and that by various conjunctions of these atoms all bodies are formed. In all cases, whether as atoms or in the mass, matter is for the sense a lifeless, powerless, motionless substance; utterly inert, except as something is done to it, and in itself only existing to occupy and cumber the place it fills.

When matter is subjected to a nicer scrutiny in experiment, the conception is more extended, but not at all corrected. It is observed that matter in bodies is perpetually altering its qualities, and though often by slow gradations, yet in all cases matter is moving from present modes of existence and transmuting itself to other forms. Fermentation carries its changes through the successive saccharine, vinous, and acetous stages: the atoms crumble, and the hardest bodies become disintegrated, and these again are made the elements of new compounds: living agencies are assimilating and building up new bodies, and the life goes out, and the body again dissolves, and their elements are scattered; and colours, densities, magnitudes, indeed the qualities of every sense glide from one into another, and nothing abides permanently. All things flow. We sometimes speak as if one portion of matter moved or changed other portions, and that thus matter was conceived as itself active in producing its changes; but a partial reflection again qualifies this language, and we speak of powers and forces given to matter, and that the imparted force, and not the dead matter, does all the work, and makes all the changes. The highest conceptions of the sense will therefore be, that matter itself is not cause except as a causal efficiency is given to it; that the forces and powers of nature are superinduced upon matter, and are something other than matter; matter is mere *inertia*, and all changes are wrought in it, and not by it. When such a conception is subjected to the insight of reason, it is found utterly empty. What can this passive and inert existence do? At rest it cannot move, and moving it cannot rest, without a force supplied to it. It can neither change nor resist change, neither combine nor dissolve, neither sustain nor press, except as power is given it to do all the work. Put it where we may, it is utterly a *caput mortuum*, neither acting nor re-acting; the force given to it does all things for it. How can it be *known?* In any sense, receive an impression and thereby a sensation, out of which the intellectual action brings a distinct and definite perception, that impression and sensation must have been induced, not at all by the dead matter, but by some efficiency put into the dead matter, and it must be this and not the matter that becomes object in perception. What, then, can it *be?* It cannot *exist*, for it cannot *stand out* in any sense; it cannot *sub-sist*, for it cannot *stand under* any quality; it is wholly a negation, and if we should attempt to conceive of it in any way as object, it would be the absurdity of an object that could not be put before any organ of sense.

We must, therefore, wholly renounce such a conception of matter. Let us, however, keep this *force* which we have supposed to be supplied to matter, and which we have found in such case must work all the mutations that occur in matter, carefully subjected to a rational insight, and determine whether indeed this force that does all that is done, is not matter itself. Simple activity is spiritual activity, and *has nothing in it* that can awaken the thought of force; and it is only as it meets some opposing action, and encounters an antagonist, that we can come to have the notion of force. In all push and pull there is counteraction, complex action, action and re-action, while simple spiritual agency can never be made a conception of *physical* existence. It cannot be thought as taking and holding any fixed position: it cannot become a permanent and have a "where," that it may be conceived to pull from a "there," that it may be conceived "to push to." It could not be determined to any time nor any place, for it has no constant from whence the determination might begin, nor where it might end. When, however, the conception is that of the simple in counteraction, an activity that works from opposite sides upon itself, we have in it at once the true notion of force. From the difficulty of clearly apprehending counteraction or antagonism in a single activity, as always acting in opposite directions upon or against itself, and which must be the true conception; for the notion is that of one source for the antagonism, it will be more readily taken and equally available in the result, if we have the conception of two activities meeting each other, and reciprocally holding back, or resting against each other, and thus of the two making a *third* thing at the limit of meeting, which is unlike to either. In neither of the two activities can there be notion of force, but at the point of antagonism force is generated, and one new thing comes from the synthesis of the two activities. To distinguish this from other forces hereafter, we call it *antagonistic force.* In this *position* is taken, and there is more than the idea of *being*, which the simple activities each have, there is being *standing out*, an EXISTENCE being *in re*, *reality*, A THING. Let, then, an indefinite number of such positions, contiguous to each other, be conceived as so taken and occupied, and a space will thereby be filled and holden; an aggregate force will maintain itself in a place; and a ground is given on which other things may rest. A substantial reality here exists. This antagonism may be conceived to be of any degree of intensity, and the substantial ground will hold its place with the same amount of persistency, and stand there permanent, impenetrable, and real. Nothing else may come into its place until itself has been displaced. It is not *inertia*, but a *vis inertia;* a force resting in itself, and thus holding itself in place. This conception of antagonism alone, though adequate to give substantial matter, will not be found adequate to give such forms and modes of matter as a universe needs for the rational ends designed in it. *There will need to be varied substance; combinations and resolutions;* perpetual changes and processes through successive stages; and thus our primitive idea of matter must comprehend more than the idea of pure antagonistic force, even that which may dissolve and become a combination with pure antagonism. We conceive, then, of an activity going out in exactly the reverse process of antagonism, even a beginning in the same limit of the meeting simple activities, and working on each side away from the limit; a throwing of simple activities in opposite directions from the limit of contact. Not a counteracting and resisting, but a divelent and disparting activity; not an antagonistic, but hereafter known as distinctly a diremptive movement. Such an activity could not be conceived as space-filling of itself. Wherever the limit in which there might be conceived the contact of two simple activities should be, the diremptive movement would be away from that limit on each side, and thus a space-vacating and not a space-filling activity—if this diremptive movement be conceived as at the very limit and point of contact of the antagonism, the antagonist activity working towards itself in the limit, and the diremptive activity working from itself out of the limit, then must the diremptive movement on each side encounter the antagonistic movement, and the simple diremptive activity going out on one side from the limit, will meet the simple antagonistic activity on the same side coming to the limit, and these two simples of the opposite *kinds of forces* must make a new counteraction among themselves. And equally so with the going out and coming in of the opposite kind of forces in their simple activities on the other side of the limit, the one must encounter the other, and engender a new counteraction among themselves on this other side. The result must be, that while the diremptive activity disparts and loosens the antagonism, the antagonistic activity on the other hand restrains and binds in the divellency, and thus the diremptive can neither go off wholly on either side and leave the limit void, nor the antagonism come up from each side and make the limit full, but both antagonism and diremption meet in the limit and make a third thing, which may be called indifferently an antagonistic force loosened, or a diremptive force fixed.

The pure forces in their contact in the simple limit may be known as *units*, under the term of *molecules* or *molecular forces;* the working to the limit constituting an antagonistic molecular force, and the working away from the limit constituting a diremptive molecular force. The combination of these forces, in their joint interaction making a new compound as a third thing unlike to either alone, may be known also as a unit, constituting a *material atom*, and which may farther on be known as a *chemical* atom or molecule. Our conception of matter must therefore be of this combination of distinguishable forces. In the manner here used, creation has the meaning of origination; the putting forth of something where before there was nothing, and this something thus set forth a new thing which had not previously an existence. It does not involve the impossible thought of existence coming out of a void of all being. There can be no Creation without a

Creator. It cannot escape observation how completely this reasoning accords with that of Prof. Draper, on the independence of the physical forces.

So when we examine the doctrine of the correlation of force, as propounded by Grove, Radclyffe, and Matteuci, we shall find that there is nothing therein contained to support or justify the theoretical opinions, which, emanating from Dr. Carpenter, have grown into such proportions under the facinating touch of two distinguished American chemists. There is no equivocation, but we are distinctly taught that the solar beam is the messenger of God, carrying the principle of life, or what may be converted into life, wherever those beams of light may travel. Not only is the organic framework placed in immediate dependence on these so-called forces, but the whole organised world, from the monad to the intellectual man, is but the differentiation of solar light. We apprehend, then, that a very wide distinction must be drawn between the Carpenter school and that of Mr. Grove: the teaching of the latter is certainly more in accordance with what the larger class of mankind will feel inclined to accept, and which we feel must ultimately be received as being in harmony and in agreement with the laws of nature and revelation, as we have found it to be with common sense.

We have no hesitation in adopting the philosophy taught in Scripture as a stand-point of comparison, inasmuch as it is the one which the sceptic assails, and also that which is the most ancient. In that system of philosophy we are taught that substance is ***endowed*** with attributes, offering a contrary doctrine to that of Spinosa and *his* followers, who declare substance to be the *cause* of its attributes, and above all declares the existence of a power capable of intelligently creating. "Can we, indeed," urges Mr. Grove, "suggest a proposition, definitely conceiveable by the mind, of force without antecedent force? I cannot, without calling for the interposition of creative power, any more than I can conceive the sudden appearance of a mass of matter that comes from nowhere, and formed from nothing." Now it cannot escape observation that in making out their case, the transformationists are forced to commence their superstructure on a well laid foundation, not however planted by themselves, but existing ere they commence to build. Both Messrs. Draper and Carpenter admit that, so far as organic matter is concerned, there must have been a protoplasm or parent cell from which the race proceeded: that no combination of physical causes are adequate to the formation of an organic being, however humble its form and organisation may be; for if we expose in a glass some spring water to the sunshine, though it may have been clear and transparent at first, it presently begins to assume a greenish tint, and after awhile, flocks of green matter collect on the sides of the vessel in which it is contained. On these flocks, whenever the sun is shining, bubbles of gas may be seen, which if collected, prove to be a mixture of oxygen and nitrogen, the proportion of the two being variable. Meantime the green matter rapidly grows, its new parts, as they are developed, being all day long covered with air-bells, which disappear as soon as the sun has set. If these observations be made on a stream of water, the current of which runs slowly, it will be discovered that the green matter serves as food for thousands of aquatic insects, which make their habitations in it. These insects are endued with powers of rapid locomotion, and possess a highly organised structure ; in their turn they fall a prey to the fishes which frequent such streams. Organic chemistry teaches that it is the office of *vegetable life to form from inorganic matter* organised molecules, and furnish them as food for the support of animals which simply assimilate, but do not fabricate ; we must therefore infer that the fibrine, the albumen, the gelatine, the fat, and whatever else of those compound organic molecules is required for the support of fishes and insects, are originally formed *by the action of light on that green matter. But the production of this substance is the result of a multitude of coincident actions.* The sun light is the agent which directs its growth, but it does not so plainly appear what is the body from which it originally springs, and *on which* the light exerts its influence; whether it comes from microscopic germs, which, floating about in the air, find their way into every water, or from organic cells furnished from obscure sources. "So far," says Dr. Carpenter, "as we at present know, every plant and every animal is the offspring of a parent, to which it bears a resemblance in all essential particulars; and the same may be said of the individual cells of which the composite animal and vegetable fabrics are composed. It does not always seem requisite that *a definite* germ particle should have been prepared by a parent cell; for there appear to be cases in which new cells originate in the midst of a homogeneous protoplasma, in which no distinct germs can be detected. *Still that fluid must have been prepared* and elaborated by cell agency: the first stage of cell-formation consists in the appearance of aggregations of molecules, forming nuclei, from which the cells grow; and these new cells bear the same relation to those which prepared the protoplasma as if they had originated in distinct germs or reproductive molecules." The doctrine of spontaneons generation being abandoned by all physiologists, we find both our authors as above quoted admitting the necessity of a *living* organism, however diminutive, as the parent of the subsequent progeny, be it vegetable or animal cell. Now, then, we would ask, is this parent cell capable of transmitting *all* its attributes to its descendants, or does it only transmit a portion, the remainder being the effect of the operation of certain external powers?

We believe that physiological science is quite capable of proving that, so far as the operation of external forces are concerned, they in no way effect the *typical form* of the creature, nor do they in any way influence the nature nor production of the inner life of the being which is bound up in, and is peculiar to, the organism in which it displays its phenominal existence; it is impossible, indeed, to explain the operation of the most important general laws of physiology or natural history, unless we admit that the attributes of substance are as much its essence, as are extension and impenetrability the admitted essentials of matter; the idea of substance involves the necessary idea of attributes, so that the conception of the one involves the necessity of the conception of the other, for we must even conceive of substance when conceiving the Spiritual.

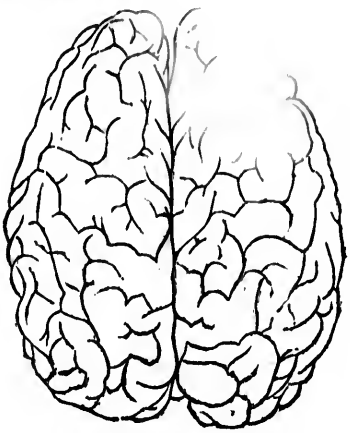
In order to discover the truth of this statement, let us revert to the proposition made by Mr. Grove, wherein it is clearly laid down "that light is the result of the vibrations of matter itself, and not from a specific ether pervading it;" either on this hypothesis or on the ethereal, light is the result of undulation or motion in the atoms of matter; but according to Mr. Grove's theory, light is the result of vibrations in matter diffused in all space, and which matter, bathing all bodies in space, is itself acted on by these bodies. It would appear from this theory that light was not an essence, but the evidence of the particles of matter being in a peculiar state, or of their having assumed a definite arrangement, by which they become capable of inducing an analogous condition in other particles of matter, or else totally dissimilar conditions, such as heat, motion, electricity, &c. To say, therefore, that the sun is the *cause* of light, is not really true, for we know that there are many other bodies besides the sun, whose constitutions vary, and yet they are quite capable of emitting light; in other words, are we justified in accepting as established the doctrine of secondary causes, which is resorted to as a ready method of solving some of the most perplexing problems. Phosphorous in one state is luminous, in another it is not; carbon in one condition is a black mass, in another it is a brilliant gem. Chemists explain these and such like phenomena, by stating that such bodies are in a state of allotropism or isomerism; or, to explain more definitely, many of the elements may exist under two or more different conditions, called allotropic states. In one state they readily exert their usual active properties, in the other they seem passive, and, as it were, torpid. The diamond is the passive form of carbon, and it can hardly be made to burn in oxygen gas; while lamp black, which is one of its active forms, is so highly combustible that it often takes fire spontaneously in the open air, and it is supposed that these conditions of the elements are retained when they enter into combination. Isomeric compounds are such *as contain the same* elements in the *same* proportions, and yet have *different* properties. Formerly it was supposed bodies, having the same chemical constitution, must necessarily have the same qualities, but such is now proved not to be the fact. Spirits of turpentine, the oil of lemons, oil of juniper, oil of black pepper, and oil of bergamot, contain equal amounts of carbon and hydrogen, yet *their properties* are very different. Oil of roses and illuminating gas are also identical in composition. The difference in isomeric bodies is accounted for by supposing that the atoms or molecules are differently arranged in the different cases; but so far as *the cause* of the phenomena is concerned, we are just as much in the dark as ever. Why should the same particles which enter into the composition of spirits of turpentine and oil of lemons, by dissimilar arrangement merely, be capable of manifesting such very different physical properties? *The substance* here is evidently not the cause of its attributes, but it is the form which the substance has assumed; and what has caused it to assume the particular form? There is surely something in the form and arrangement of bodies which demands more attention as connected with phenomena than it has yet received, yet we cannot suppose "form" to be *the cause* of new phenomena; but what becomes of the famous declaration, that substance is the cause of its attributes, for here we have virtually the same substance but with differing attributes? What, then, shall we conclude? That in the matter and form of substance are included the phenomena to which it gives manifestation, so that it is more correct to say that substance is necessary for the manifestation of attributes, or that substance contains its attributes, than that substance is *the cause* of its attributes; indeed, what do we know of substance except through these; and, as Mr. Morrell observes, "after all the disputes about infinite divisibility on the one hand, and ultimate atoms on the other, it may, perhaps, at length be found that a system of monadology is the most intelligible theory; that the most correct notion of matter is that of a combination of forces, which produce certain impressions upon our minds, and to which those minds necessarily attribute certain material properties. Thus it may turn out that the mode in which we are now accustomed to view material masses in physical science, namely, as powers acting in certain directions, is metaphysically, as well as mechanically, true." According to Prof. Carpenter's theory this is impossible, viewing, as he does, the external physical forces as outward entities; he constructs for them a stage on which they not only manifest themselves, but in turn become the cause of other manifestations. But we have endeavoured to shew that, in accepting the dynamical theory, we cannot explain intelligibly the physiological doctrines of the London school, and we shall fully illustrate the inconsistencies by reference to its own dogmas. In like manner, we freely confess being incapable of understanding M. Cousin, and some others who, while speaking of a Creator in language which seems to accord all the attributes of perfection and absolute power, nevertheless unhesitatingly limit that Creator's power and absolute perfection by denying Him the power to create at all; for surely the power of creating, which M. Cousin assigns to the Deity, is not creation at all, but simply the power of differentiation or submergence: thus, M. Cousin observes, "God creates by virtue of his *creative power:* he draws the world, *not* from nothing, which *is not*, but *from himself*, who is absolute existence. *His prominent character* being *an* ABSOLUTE CREATING FORCE, which cannot avoid exercise; it follows not only that creation is possible, but that it is necessary. Further, God creates with himself: then he creates with all the qualities which we have recognised in him, and which necessarily pass into his creations. God is in the universe as the cause is in its effects." Sir William Hamilton's doctrine is equally objectionable, and has been ably answered. Restricting our remarks more immediately to M. Cousin's theory, we would ask whether

"God's prominent character, being *absolute* creating force," is not virtually destroyed by the declaration that "he draws the world *not from nothing*, but from himself, who is *absolute existence?*" There was then no creation, for all things, according to this doctrine, already existed in God, who has passed into creation; indeed, it would be necessary to invent a term or terms to express the doctrine, since creation is, according to it, impossible; it would be much more accurate to declare that all things are but the products of germination, and not of creation. Further, the liberty of God is circumscribed, and He cannot but choose to create, because He is not only absolute creating power, but creating power always in action. Here, then, M. Cousin would force us to believe that absolute power is, after all, but *limited* power, since it has not the power to control its own action, as well as a creative power who does not create, but uses that which already exists to effect his purposes, namely, its own substance. We fully admit that "the eternal power and goodness are plainly seen by the things that are;" we are confident that in viewing "material masses as powers acting in certain directions," we do trace or see as through a glass darkly the grand and transcendent power which originated them, and believing that our best conceptions of power are derived from mind, we can understand that Absolute Creative Power was quite equal to the task of creating that which was not itself, but different from itself, in virtue of the power of the Divine Mind—in short, deny the *capacity for creation* to be absolute, prove that the power to create *is not* an absolute power, and you destroy its character as absolute. In answering Sir W. Hamilton, Mr. Calderwood has, we conceive, put the question in its true light, and most ably refuted its pantheistic tendencies; he says, "If we examine our consciousness, we shall find that there is always an element of power in our notion of a cause, a fact for which the theory of Sir William entirely fails to account. Our notion of causality is not embraced under the notion of a mere *continuance of existence;* it is not even embraced under a notion of a change in the *form* of existence. A cause is that on account of which the change occurs; it is that which *produces* the change. Take, as an example, a stone broken in two by the stroke of a hammer. We perceive the two pieces of stone, we think them as having previously existed in one whole; but we have yet to think that a certain power has separated them, before we have realised our notion of causality. Without realising in the mind the necessary belief that there has been an operation of power, we fail to identify our notion of causality; and as neglecting this, the theory of Sir William Hamilton does not embrace the phenomena to be explained." Again, we may take an illustration from what takes place in our sense of sight, when we look at an object; do we see *the thing* we look at? does the mind lay hold of the object immediately? The answer is unhesitatingly, no! we perceive and mentally lay hold of the image of the thing gazed upon. Experience teaches us that the image is so perfect, that for all practical purposes it is a perfect representation, and does not give us a false perception of the object. Now, can it be said that any part of the object has passed into the mind, or that any part of the beholder has been lost, as it went forth to perceive the object. When the eye of the engineer beheld the steam from boiling water raising with force the lid of the kettle, his mind conceived the steam-engine which his hands afterwards brought into existence: how much of the man passed into the instrument? Did the image of the wreath of curling steam, or any part of the vapourised water, pass into the mind? It appears, therefore, to be clear, that if we admit a creative power which is absolute, perfect, unlimited power, we cannot curtail or circumscribe its action or capacity for action in any way. Now M. Cousin would no doubt admit that as cause, he argues for no closer identification than that which is above admitted: thus he says, "To create is a thing not difficult to be conceived, for it is a thing that we do every moment; in short, we create every time we perform a free act. I will; I take a resolution; I take another, then another still; I modify, I suspend it, I pursue it, &c. What is it that I do? I produce an effect which I refer to myself as the cause, and only cause; and in regard to the existence to this effect, I seek nothing beyond myself. We create a free act; we create it, I say, for we refer it to no principle other than ourselves; we impute it to ourselves, and to ourselves alone. It existed not; and now it begins to exist *by virtue of the causative power* which we possess. This, then, is to create; but with what? with nothing? No, doubtless; but, on the contrary, we create even with the foundation of our existence. Man draws not from nothing which he has not yet performed, but is about to perform. He draws it from the real power which he has to perform it. Divine creation is of the same nature." Dr. Harris has employed language equally strong, without finding it at all necessary to draw the objectionable inferences which M. Cousin does; he observes, "That every divinely originated object and event is a result of which the supreme and ultimate reason *is in the Divine Nature*. By which we mean that not only is *a* reason *for* it to be found there—this would only acquit the maker from a charge of folly—but that the ultimate and adequate reason, that it is, and what it is, is to be found there. For if the origin of every thing which may exist must be traced to him as the first great cause, every thing will, in some sense, be like him; *i. e.*, it *will be*, and will be *what it is*, when it proceeds from him, because he is what he is; for before it was produced, it was potentially included in him. Additional reasons may be found in itself, and in other parts of creation, to account for its existence. And of vast significance may many of these reasons be to the creature. Yet all these will be found subordinate and traceable to that infinite reason which includes, *but is* INDEPENDENT of them all, as belonging to the infinite nature of God. These subordinate reasons may be only co-existent with the respective natures in which they are found—beginning and ending therefore, in some cases, in a few short hours —soon, and perhaps for ever, to be forgotten by all the rest of creation ; but the infinite reason of their being at all, existed from eternity, in the nature of God, and can never cease to exist. However insignificant, comparatively, any creature may be, not only is the reason of its existence to be sought in God, as prior to, in the order of time, and causative of, that existence ; but as a reason which approved itself it to, and in some sense expressed a property of, the Divine nature. So that even if there were no purpose of manifesting Divine all-sufficiency—but the creation even to be limited to the production of a single creature—still as every effect must be in some sense like its cause, that single effect would be (not *formally* but *virtually*) a manifestation *pro tanto* of the Divine nature ; in other words, its ultimate *reason* would be found in God." And "Thoughts of Pascal," quoted by M. Cousin in his third note, still more conclusively shew how unfortunate the great French philosopher is in his mode of expression, since he approvingly adopts Pascal's language as a true statement of his own opinions. "Let us," he says, "speak without circumlocution. What is pantheism? It is not an atheism disguised, as they say. No. It is avowed atheism. To say in presence of this universe, so vast, so beautiful, so magnificent, God is there entire—behold God, there is no other; is to say as clearly as possible that there is no God, for it is to say that the universe *has not a cause essentially different from its effects.* However immense it may be, this world is finite in itself, compared to God who is infinite; he manifests, but he also veils his grandeur, intelligence, wisdom. The universe *is the image* of God; *it is not* God; something of the cause passes into the effect, it does not exhaust itself there, and it remains *entire.* The universe itself is so far from exhausting God, that many of the attributes of God are there covered with an obscurity almost impenetrable, and are discovered only in the soul of man. The universe is a necessity; but the soul is free; it is one, simple—essentially identical with itself under the harmonious diversity of its faculties; it is capable of conceiving virtue, and accomplishing it; it is capable of love and of sacrifice. Now we are averse to believing that the being who is the first and last cause of this soul is an abstract being, possessing less than he has given, and having himself neither personality, nor liberty, nor intelligence, nor justice, nor love. Either God is inferior to man, or he possesses at least all that is permanent and substantial in man, with inferiority besides." God then created by virtue, not of necessity, but of his own free will and determinate action, because he deemed it best to create ; and in creating he was cause and source of all things, and remains by virtue of his all-sufficiency *the* cause of all things. Endowed from the beginning with attributes and powers, the display of those powers are surely not causatively brought out by the substance through which the manifestation is made ; on the contrary, the material substratum is made the stage on which is manifested the power of the cause of its existence, although it may be quite incapable of explaining the nature of that cause. It is no doubt true that we cannot realise in our minds the time when nothing was, since we cannot idealise the time when power to produce something was not ; nevertheless it by no means follows that the cause of something enters actually into that something. That, however, which was primary cause cannot be annihilated or set aside by another cause, since it must always have some relation to the effect, for after all, what are commonly called secondary causes are really but themselves effects ; thus light or heat, which are the results of motion in the matter of the interplanetary space, is caused by the peculiar arrangement of the matter of the sun, which in contact with that matter allows the phenomena of light or heat to be displayed. These particles of matter manifesting such affections, in like manner, by their presence, furnish conditions for further effects in inorganic or organic bodies. Heat falling on a seed or an egg, there follow actions of a peculiar kind, and it is generally said that heat is *the* cause of the life developement; but how many other conditions are there to be complied with, ere the animal is fully developed? Heat furnishes one of those conditions which enables the seed to germinate or the egg to produce the bird. Dr. Carpenter objects to the doctrine which declares that the cell-germ contains within itself all the elements, or rather power of its future life, and teaches that the offspring is not potentially included in the parent and transmitted to it. What shall we say, then, of the facts which the chemistry of inorganic bodies unfolds? Here we discover elements which, while they remain the same, nevertheless are capable of existing in a variety of states, carrying along with them frequently into the new alliances or conditions on which they enter some of their special or peculiar attributes; while on the other hand we perceive a display of new or previously unknown ones when new associations are formed. Thus, chlorine remains in all essential particulars the same whether acted on by light or not, yet it will no longer bleach coloured bodies if kept in a dark place. Oxygen, we know, may exist in different states, exercising various powers; and carbon is no less possessed of like endowments. To every substance was given all and every its attributes, and these are as various as may be conformable to a general plan of uniformity and to the law of harmony, traceable every where in nature. Is it less marvellous that we notice inorganic substance endowed with properties which they display only when in particular circumstances, than that there should be in organic beings, which possess the inherent property of sustaining themselves, the power of self-construction and multiplication? If, therefore, we do discover degrees of progression—gradational steps from higher to lower forms—and if we should discover that, together with the form and material, are present diverse attributes, is there any logical necessity for the inference, that all things are absolutely and really the same? The attempt which has been made to reduce all things to absolute oneness has failed, and, as in the instance of light and heat, clearly reveals to us that the monads which make up matter by re-adjustment or change of state, and may give rise to the phenomena of electricity, heat, light, motion, are evidently diverse. Prof. Draper's experiments on light, and Melloni's on heat, are very instructive, and lead us to infer that however close the relationship may be, that there is really an essential difference in the elementary particles or atoms. Thus, accepting the doctrine of monadology, we may explain that the solar beam is composed of monads which, being differently arranged, manifest diverse properties, and that the arrangement in each particular ray of the beam was originally given to it, and that it has not the capacity to part with it. Thus, the peculiar properties of a particle of lead may appear to be lost when acted on by acetic acid ; but, under the flame of the blow-pipe on charcoal, the original metallic qualities of the metal may be restored ; the instances may be multiplied to an indefinite extent. Mr. Crombie observes, "When the atheist ascribes to matter active independent powers, and on this assumption erects his hypothesis and constructs his universe, we contend that, until he can produce clear and incontestible evidence that matter produces such active power, his argument must be dismissed as mere assumption. Power is strictly the attribute of a voluntary agent, and its exercise subject to his will. It is not an object of perception, but an inference of the understanding ; nor is our notion of it acquired, as Hume supposes, from the constant conjunction of certain phenomena, and the habit of passing in imagination from antecedent to consequent. We may, indeed, thence derive our notion of cause and effect ; but our notion of power is different from our notion of cause, the former being apprehended as that by which the latter is understood to produce its effect. It is evident that our notion of active power is derived from our own energies as understanding and willing beings. Hence it follows that the only intelligible and distinct conception that we can form of power, is, as Dr. Reid has observed, "that it is the attribute of a being who can do certain things if he wills, and that it can exist only in beings that are endowed with understanding and capable of volition." It cannot belong to inanimate substance, though matter, like a tool in the hands of a machinist, may be made an instrument subservient to the purposes of a Supreme Intelligent Power. Mr. Morrell observes:—

"The universe presents to our view innumerable objects, which are finite, changeable, and dependent. All of them consist of certain forms and attributes, united to a substance or substratum. But substance, in its finite and dependent form, cannot be self-existent; for it has come into that form from a previous state, *i. e.*, has been brought into it by a prior cause. Go backwards accordingly in the chain of causes, and you come at last to an absolute cause. There must be, therefore, something previous to finite existence which we call *Being per se*, something which is self-existent, underived, absolute, eternal. Under all the fleeting appearances which nature presents, there is something *abiding*, which reposes alike at the basis of all—a Being which passes not away with her changes. Here, then, is the dawn of the *infinite*, upon the human mind—an idea which is soon reproduced in numberless different forms. Think of *space*;—we see it stretching out beyond the world, beyond our system, beyond the furthest limits of creation; and every bound we affix to it only carries us to the unbounded beyond. Think of time;—all the limits of duration do but suggest the illimitable eternity. Think of dependent existence;—and we sink lower and lower from one stage of dependence to another, till we rest only in the independent, the absolute. Think of *finite being*;—what is it but an endless paradox without infinite being? Think of *cause*;—what does it end in, but the *causa causarum*, the spring and source of all things. The idea of the infinite is necessary, absolutely necessary, to perfect the full conception of God. But this idea comes not from without. We can never see, we can never have any experience of *infinite being*, and yet this is a *positive* idea, an idea of which we feel the reality and necessity; yea, without which, all being were but a paradox. The *finite* is really the negative idea; *it only* comprehends limitation and negation, a limitation which is universal within the regions of our sensuous knowledge. But reason, taking its start from the finite, brings us infallibly to the infinite; and inasmuch as two infinites involve a contradiction, it finds here the proof of the *unity* and the *eternity* of the first great cause. Nature, then, gave us a demiurge for a Deity: reflection now asserts his unity, infinity and eternity; and we have thus before us the *absolute Being*, without which all thought, all creation, all nature, would be involved in one inexplicable contradiction. As polytheism was the prevailing sentiment under the former conception, so pantheism appears to be on the whole the prevailing result of the second or metaphysical stand-point. But if there be any such thing as truth at all, if there be any common principles on which the human reason can rest, then assuredly the universe has a ground, or cause, and that cause is self-existent, absolute, infinite, eternal. But again, we rise into another region of proof, and that is *the moral.* The only *personality* of which we have any direct knowledge, is that of our own minds. We must take mind, therefore, as a field of observation—as a created effect, and see what we can learn from this effect of the infinite *cause.* Humanity is not *self-created.* The reason we possess is not constructed by us out of a state of unreason. If, therefore, it is implanted in us, then the being who implanted it, the Creator of the spirit, must *himself* possess reason. So it is with our moral sentiments. If there is a law of right and wrong engraven upon our constitution, there must have been a lawgiver. All the appeals of innocence against unrighteous force are appeals to an eternal justice, and all the visions of moral purity are glimpses of the infinite excellence. In a word, if we see in nature, in mind, in history—if we see in every region of the Divine operation, intelligence adapting means to an end ; if we see moral sanctions expressed and implied in the natural tendencies of human action ; if we see all this, moreover, effected by a supreme intelligent *power*, that is, a Divine *will ;* then from the conceptions we have of intelligence, moral sentiments, and will, as existing in our own personality, we are constrained to regard the being from whom they all flowed as himself a personality, in which all these attributes exist in their fulness and perfection. And then, at length, when we have once attained the idea of a Divine personality, we may go back again through all the realms of nature and existence, and gather new delight from the infinite illustrations of power, wisdom, and goodness, which they perpetually show forth. Thus it is, that the teleological, the ontological, and the moral arguments, blend in one, and mutually support each other. To extort from nature alone, a complete proof of the Divine personality, is throwing ourselves into a false position, and weakening our argument by making it prove too much. That nature has a *cause*, every one who speaks intelligibly must admit. The main object of the ontological argument, is to prove that this cause is infinite, self-existent, *one ;* while that of the moral, is to prove that he is intelligent, holy, free. Having arrived at this point, we have wherewithal to ground our belief in the authority of revelation. The internal and external evidences can now both appeal to the power and purity of the Divinity; and then, its claim to the title of a Divine message being once established, revelation can carry us onwards, in our conceptions of the Divine nature, to a still loftier elevation. Thus revelation, while useless at the basis, may yet become the crowning piece of our natural theology. Give it but a pedestal to rest upon, and it may lead us into the loftiest regions of Divine knowledge, which are accessible to humanity in its earthly state. Such is the brief outline of what we regard to be the true nature of the theistic argument. Were we required to point out the region in which the whole argument is best concentrated, we should refer to *man*, as himself a living embodiment of all the evidences. If you want argument from design, then you see in the human frame the most perfect of all known organisation. If you want the argument from *being*, then man, in his conscious dependence, has the clearest conviction of that independent and absolute *one*, on which his own being reposes. If you want the argument from reason and morals, then the human mind is the only known repository of both. Man is, in fact, a microcosm—a universe in himself; and whatever proof the whole universe affords, is involved *in principle* in man himself. With the *image* of God before us, who can doubt of the Divine type?"

But for the stability of the properties of matter, all the rigid calculations of the mathematician, geometrician, or chemist, would utterly fail, and scientific truth come to an end. We infer that heat, light, electricity, motion, are affections of matter which must have been when the broad foundations of the creation were laid, since we can trace their presence in the remotest age to which observation may be made. Oxygen, hydrogen, nitrogen, carbon, must have all had the peculiar attributes or properties which they are at all capable of displaying from the very instant of their creation. "When a phenomenon," observes M. Cousin, "presents itself with such a character in such a circumstance, and when, the circumstance changing, the character of the phenomenon changing also, it follows that this character is not a law of the phenomenon; for this phenomenon can still appear, even when this character no longer exists. But if this phenomenon appears with the same character in a succession of numerous and diverse cases, and even in all the cases that fall under the observation, we hence conclude that this character does not pertain to such or such a circumstance, but to the existence itself of the phenomenon. Such is the process which gives to the physical philosopher, and to the naturalist, what is called a law. Where a law has been thus obtained by observation, that is, by the comparison of a great number of particular cases, the mind, in possession of this law, transfers it from the past to the future, and predicts that in all the analogous circumstances that can take place, the same phenomena will be produced with the same character. This prediction is induction; induction has, for a necessary condition, a supposition—that of the constancy of nature; for, leave out this supposition—admit that nature does not resemble herself, and the night does not guarantee the coming day—the future eludes foresight, and there no longer exists any thing but arbitrary chance: all induction is impossible. The supposition of the constancy of nature is the necessary condition of induction; but this condition being granted, induction, resting upon sufficient observation, has all its force. In the *moral order*, the same processes severely employed, conduct to the same results, to laws which give to the moralist and the historian, quite as well as to the physical philosopher and the naturalist, the right to forsee and to predict the future." We have alluded to the composition of light as illustrative of the doctrine which we desire to establish; a review of Prof. Draper's experiments afford evidence enough on this point. Thus, in the solar spectrum, we discover that of the rays of which it is composed no one possesses precisely the same property, as manifested in its behaviour to other bodies; but, on the contrary, each particular ray of the beam is endowed with special power, *i. e.*, each ray discovers itself to be, in its ultimate atoms, in a special state, and that all are not under the same condition. Thus, if we suppose the solar beam to be composed, say of seven rays, we may imagine, by way of illustration, the elementary monads to be diverse in each ray; thus each ray will always remain in that state. The monads of which the yellow ray is composed exercise a special effect on organisation, and induce organic particles to assume states, and exhibit phenomena, which they are alone capable of doing in the presence of that ray; the capacity for the display is in the organic particle; the passage of the potentia into actus requires that the yellow ray should be present. If, then, we find that there necessarily exists in our mind the idea of power, and if we discover that the idea which we necessarily form of power is, that it be absolute, perfect, unlimited: by a similar necessity we admit the idea of the possibility of variety in the display of power; it may display itself in any way, and in diverse ways. So that while the mind, by the completeness and perfection of the works, seizes the oneness of the worker, it also, by the variety in the *form* of the works, lays hold of differences in the works themselves as direct proofs of creative intervention. Creative power being admitted, the absolute perfection of that power being given, it follows that all creation is possible, and possible only in the most comprehensive and perfect way. In the inorganic world we behold brute matter created with powers and properties which are permanent, and are as much part of its essence as any one of the more revealed and sensible properties which it possesses. We witness changes of form and new arrangements of elements, accompanied by new, or rather varied phenomena, and we attribute the appearance of these phenomena to that change. In organic bodies we behold like results, following the form or differentiation of matter. Are we, therefore, entitled to infer the absolute oneness of all matter and material forms? Are we, of necessity, to *limit* the absolute power and perfection which has been previously admitted, and to declare that Absolute Creative Power can only create unity, without diversity? We certainly have no such right; we cannot even entertain the idea without contradiction. The phenomena themselves were created with the substance, and although we cannot say *how* attributes may dwell apart from substance—for the Creator of all things is substance—it does not follow that it was impossible to create substance which was compound in essence, or that the simples of the compound should have the capacity of existing in a separate form. We certainly cannot understand how the light of the sun could exist in its purity, if its present constitution was altered; we think it and speak of it as light, as one agent: the elements of which it is composed co-exist; we may artificially prove their separateness by experiment, as is shewn in their behaviour to other bodies; nevertheless their different elements are necessary to the perfection of a solar beam. In organic bodies we may also have elements conjoined, which are diverse and separate; we hold, therefore, that there is nothing inconsistent in the doctrine which declares an ascending differentiation in organic bodies, accompanied both by differentiation of form and differentiation in the phenomena, until at length we arrive at a point of differentiation at which we find the inorganic forms extreme, and the phenomena so differentiated as to have become capable of dwelling apart from their substance; that boundary line at which material and immaterial rest against each other. We, therefore, unhesitatingly believe the form to be essential, as an evidence of differentiation; we unhesitatingly admit a Creative Power, equal to any and every emergency, unlimited in power, absolute in perfection, and therefore able to create "by the power of his word, objects which may endure for a moment, or that shall live in an unending eternity." We cannot, with Archbishop Whately, think the Creator as obliged to act within the scope of our understanding, and in no other way; on the contrary, we cannot explain *how* he acts, but knowing that he acts, we also idealize his capacity for action to be without limit.

In consequence of the substitution of dynamical for material ideas and language, the phenomena of light, heat, electricity, magnetism, motion, are almost by common consent ranked as *forces*. "I have," says Prof. Faraday, "long held an opinion, almost amounting to conviction, in common, I believe, with many others—lovers of natural knowledge, that the various forms under which the forces of matter are made manifest, have one common origin; or, in other words, are so directly related and mutually dependent, that they are convertible, as it were, one into another, and possess equivalents of power in their action." Mr. Grove, who has extended the researches in this branch of science, observes, "that the various *affections of matter* which constitute the main objects of Experimental Physics, viz., heat, light, electricity, magnetism, chemical affinity, and motion, are all *correlative*, or have a reciprocal dependence; that neither, taken abstractedly, can be said to be the essential or the proximate cause of the others; but that either may, as a *force*, produce the others." In order to explain the idea of "correlation," Dr. Carpenter states, "force A, operating upon *a certain form of matter*, ceases to manifest itself; but B is developed in its stead." Now what we are concerned in shewing here, is the supposed existence of a something *ab extra*, or something which, entering or operating on "*a certain form* of matter," is not changed itself, but changes or affects the matter on which it acts. We do not mean to state this as a truth, for we have had reason already to suppose that, between matter and force, there is a correlation more striking even than that stated by Mr. Faraday; the affections of matter being part of the essence of matter. Dr. Carpenter, in his "Human Physiology," remarks, "the essential nature of these two entities—*mind* and *matter* —is such, that no relation whatever *can* exist between them." Matter possesses extension, or occupies space; whilst mind has no such property. On the other hand we are cognizant of matter only through its occupation of space, of which we are informed through our senses; we are cognizant of the existence of mind by our direct consciousness of feelings and ideas, which to us are the most certain of all realities. But what is, perhaps, a more important distinction, the existence of matter is essentially *passive;* left to itself, it always impresses our consciousness in one and the same mode; and any change in its condition is the consequence of external agency. *What have been termed the active states of matter, are really the manifestations* OF FORCES, of which we can conceive as *having an existence independent* of matter, and as having no other relation to it than that which consists in their capability of *changing its states.* Thus, water continues unchanged so long as its temperature remains the same; but the dynamical agency of heat occasions that mutual repulsion between its particles, which transforms it from a non-elastic liquid into an elastic vapour; and all that heat is given forth from it again, when the aqueous vapour is transformed back to the liquid state. On the other hand, the existence of mind is essentially *active;* all its states are states of change, and we know nothing whatever of it save by its changes. Sensations, perceptions, ideas, emotions, reasoning process, &c., in fact every term which expresses a mental state, is a designation of a phase of mental existence which intervenes between other phases, in the *continual succession* of which our ideas of mind consists. But whilst between matter and mind it is utterly vain to attempt to establish a relation of identity or analogy, a very close relation may be shewn to exist *between mind and force.* For in the first place, force, like mind, can be conceived of only in a state of activity; and our idea of it essentially consists in the succession of different states under which its manifestations present themselves to our consciousness. But, secondly, our consciousness of force is almost as direct as is that of our mental states; our notion of it being based upon our internal sense of the exertion which we determinately make to develope one form of force, which may be taken as the type of all the rest, viz., that which produces or resists motion. When we attempt to lift a weight, or to stop a horse that is running away, we are directly conscious of a mental exertion, as the immediate and invariable antecedent of the developement of motive power through the contraction of our muscles; and the connexion of the two is further established by that "sense of effort" which we intuitively refer to the muscles themselves, arising, as it does, from their own condition; and thus we are led to feel, that in this particular case, force must be regarded as the direct expression or manifestation of that mental state which we call the will. The analogy becomes stronger when we trace it into the relations which these two agencies respectively bear to matter. For in the phenomena of voluntary movement, we can scarcely avoid seeing that mind is *one* of the dynamical agencies which is capable of acting on matter; and that, like other such agencies, the mode of its manifestation is affected by the nature of the material substratum through which its influence is exerted. Thus the physiologist knows well that the immediate operation of the will is not upon the muscles, but upon the brain, wherein it exerts that active state of nervous matter which he designates as the operation of nerve-force, and that the propagation of this force along the nerve trunks is the determining power. He knows, too, that this dynamical metamorphosis is effected—like every other analogous change—by the *intermediation* of a peculiar material substratum, which itself undergoes a change of condition; the compounds both of the nervous and muscular substances ceasing to exist under their previous forms, and entering into new combinations. Thus, then, we have evidence, in what we know of the physiological conditions under which mind produces motion, that certain forms of vital force constitute the connecting link between the two; and it is difficult to see that the dynamical agency, which we term will, is more removed from nerve-force, on the one hand, than nerve-force is removed from motor force on the other. Each, in giving origin to the next, is itself expended, or ceases to exist *as such*, and each bears in its own intensity a precise relation to that of its antecedent and its consequent. But we have not only evidence of the excitement of nerve force by mental agency; the converse is equally true, mental activity being excited by nerve-force. For this is the case in every act in which our consciousness is excited through the instrumentality of the sensorium, whether its condition be affected by impressions made upon organs of sense, or by changes in the state of the cerebrum itself; a certain active condition of the nervous matter of the sensorium being—we have reason to believe—the immediate antecedent of *all* consciousness, whether sensational or ideational. And thus we are led to perceive, that as the power of the will can develope nervous activity, and as the nerve-force can develope mental activity, there must be a *correlation* between these two modes of dynamical agency which is not less intimate and complete than that which exists between nerve-force, on the one hand, and electricity or heat on the other. This idea of correlation of forces will be found completely to harmonize with those phenomena already referred to, which unmistakeably indicate the influence of physical conditions in the determination of mental states; whilst, on the other hand, it explains that relation between emotional excitement and bodily change, which is manifested in the subsidence of the former, when it has expended itself in the production of the latter. And, further, it will be found no less applicable to the explanation of all that automatic action of the mind, which consists in the succession of ideas, according to certain "laws of thought," without the exercise of any control or direction on the part of the individual to whose consciousness they present themselves, and which manifests itself in the action of those ideas upon the centres of movement. For this succession must be regarded as the exponent of a series of changes taking place in the cerebrum itself, in respondence to the impressions made upon it; whilst the motions which proceed from these must be considered as being no less the results of its "reflex" operation, than are the consensual of the reflex actions of the sensory ganglia, and the "*excito-motor*" of that of the spinal cord. For all physiological purposes, then, we may consider the nervous matter of the cerebrum as the *material substratum* through which the metamorphosis of nerve-force into mind force, and of mind force into nerve-force, is effected ; and as every such metamorphosis involves, like other analogous transformations, a change in the state of the matter through which it is effected ; so should we expect that mental activity would involve the disintegration of the nervous substance which thus ministers to it, and such appears to be the case.



External surface, shewing convolutions of human brain.

It is obvious that the view here taken does not in the least militate against the idea that mind *may have* an existence altogether independent of the material body, through which it here manifests itself. All which has been contended is, that the connexion between mind and body is such that each has, in *virtue of its* constitution, a determinate relation to each other, in this present state of existence ; and that the actions of our minds, *in so far as they are carried on* without any interference of our will,

may be considered as functions of the cerebrum. On the other hand, in the control and direction which the will has the power of exerting over the course of the thoughts, we have the evidence of a new and independent power, which is entirely opposed in its very nature to all the automatic tendencies; and which, according as it is habitually exerted, tends to render the individual a *free agent*.

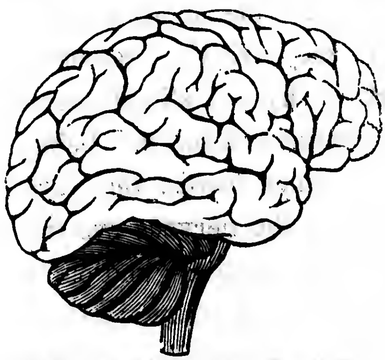
Now the manifest inconsistency of Dr. Carpenter's views are apparent, when we contrast his arguments for the independence of mind, with those which he adduces in support of his opinions on "Vital Force;" and the inconsistency is rendered yet more apparent, when viewed in connexion with the recent opinions very ably set forth by Dr. Laycock. We cannot suppose that what we ordinarily understand as "mind," is the only spiritual part of man that escapes dissolution; on the contrary, there is in his whole inner life a substantial reality—for even spiritual substances exist—which, if we ourselves saw, we should recognise as certainly as they did who once saw Moses and Elias in holy converse, although in spiritual form.

Mr. Paget's observations forcibly reveal the innate incorporate union of life and matter, and teach us to consider the whole immaterial principle as a real existence, rather than to isolate a portion of that principle, and take it as the only essential part. By such a mode of thought personality is utterly lost. "The characteristic property of the germ is, that when placed in favourable circumstances, all the materials of which it first consists, and all that it appropriates, are developed according to the same method as was observed in the developement of its progenitors; in other words, in uniformity with what we may regard as a law of specific character. In all the wonders of developement, none, I think, appear more marvellous than the constancy, the seeming tenacity of purpose with which the germ is developed to the likeness of its parents. However vast its power of multiplication and increase—however various its metamorphosis—however far in some of these changes it may deviate from the form in which its parents generated it; however near in some it may approach the perfect characters of another species; or, which is stranger still, however much alike all germs may be in their primal structure and earliest developement, yet through all these things, each germ moves, with unswerving progress, guided by the same power as created its first parents, to the formation of a being in which the parental form and properties are re-produced.

"Now, the constancy of this result, and its little dependence on external circumstances, justify the expression that every impregnated germ has in itself and in the properties with which its maker has endowed it, the power to develope itself into the perfection of an appropriate specific form. However mysterious the nature of such properties, we cannot deny their existence, or refuse to recognise a law (in the sense in which we generally use that term) in the regularity with which the power acts that issues from them when the germ is placed in favourable conditions." There is here no intermediate power standing between the Supreme Power and the organism, but it is the created organism and what are commonly called its attributes, which are in action; and surely it is not incorrect to suppose that these attributes are as much part and parcel of the reals, the essences, of which the organism is composed, as the "objectivised forces," which give us the material form, and with which its Maker endowed it.

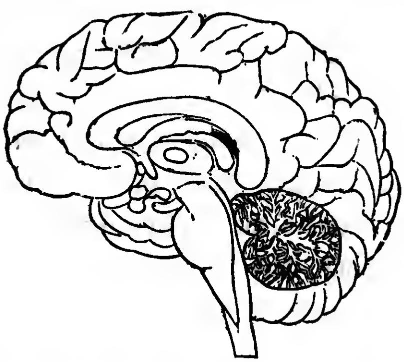
But Dr. Carpenter cannot have foreseen the full force of his reasoning, or we are satisfied that he would not have put his problem forward in the shape which he has done, for it amounts to nothing less than localising "the soul of man," the "spiritual man" in the cerebral ganglia. Now we have already shewn that all the arguments and *facts* which establish the existence of force, mind, &c., apply equally to vital force, and as fully prove its reality. If the physiologist was called on to challenge the statements of revealed truth, by the nature of the proofs furnished him by organisation or organised bodies, we might feel inclined to respect his opinions, and to wait patiently until either enlarged observation, or a more intimate acquaintance with the subject unfolded the truth; but there is really in the case before us no just grounds for doubt. The true relationship which exists between the very highest forms of organised bodies and the world around, is over and over again expressly enunciated. In the very first account which we have of the formation of man, is, "that he was formed out of the dust of the earth;" "dust thou art, and unto dust shalt thou return." To suppose, then, that organised beings are utterly independent of the world, of which they are but a part, is directly contrary to the plainest declaration of Scripture. The simple fact that "every green herb" was given for food, and that these were dependent on the former and latter rain to enable them to take their sustenance from the inorganic world, is of itself sufficient to prove to us the law of dependence which governs their respective independent kingdoms. As we have already stated, the doctrine of progression, from the general to the special, is one of those laws which seems to have governed creation. This law, including another which we may call "the law of economy," discovers to us that as inorganic elements enter into the constitution of organised bodies, so the former take with them all the properties or laws which govern them as such, controlling, or subordinating them to those other laws which are equally the property of the latter. Thus heat, light, electricity, magnetism, motion, chemical affinity, &c., forces which are incorporated in the inorganic world, are no less potent when displaying themselves in the organic. The material question which we have to keep in mind, is the extent and true nature of the connexion or relationship which the forces of matter have to life. In an admirable review, by Mr. Morell, of Dr. Laycock's work, we have a very concise statement which may help us on the point. He observes:

"The effective study of the nervous system takes its starting point from the grand discovery of Sir C. Bell, that the whole of the nerves spread in infinite ramifications through the body, are of two different orders, and perform two distinct but related functions. One portion of them, he shewed, convey impressions from all points in the circumference of the human frame to the centre; the other portion convey impulses from the centre to the various parts of the circumference. The one portion, therefore, are properly termed nerves of sensation; the other, nerves of motion; the one, afferent; the other, efferent. In this discovery we have the first idea presented to us of the nervous system as one great organ of action and re-action; as the link between the soul and the world; the instrument by which outward realities around us affect the mind; and by which the mind, as force or will, re-acts in its turn upon the world without. For some time it was imagined that every nervous impression necessarily reached the sensorium, and that every external movement, therefore, was made *consciously* in obedience to the will. Against this view, however, many well known facts began to raise well-founded doubts. It was observed, for example, that in cold-blooded animals, such as frogs and turtles, the operations of hopping, crawling, &c., could be very well performed for a time, after the severance of the head from the body. This was a sufficient proof that, in their case at least, the motor impulse could not come from the brain, but must reside in the nervous apparatus of the spinal cord. The researches, thus commenced, were carried systematically forward by Dr. Marshall Hall, until it was completely established, that in the human subject, as well as in the lower animals, there is a distinct and separate centre of nervous action in the spinal cord; and that numerous movements take place, the origin of which is not in the brain, nor in any of the sensory ganglia beneath it; but simply and solely in the spinal cord itself. These movements, of course, are performed wholly unconsciously (like the act of breathing in sleep or in apoplexy); they are the organic response, as it were, to certain physical stimuli, necessary equally for the preservation and the well-being of the human individual: in other words, they are *thrown back* from that part of the nervous system to which the stimulus especially applies; and on account of this particular characteristic, have received the name of REFLEX ACTIONS. Here, then, we see already how decidedly the nervous system, in its unconscious operations, has begun to claim for itself the origination of many phenomena which were before attributed to the direct effort of the mind, or the will; and we can judge from this fact alone how many false observations in psychology are corrected by the simple comprehension of the laws of reflex activity. The phenomena of reflex action, however, were not allowed to rest here. It was seen that the principle, once established, in relation to the spinal cord, might be carried out still further, and throw light upon many other phenomena hitherto sufficiently perplexing. Dr. Carpenter took up the investigation where it was left by Dr. Marshall Hall, and has given us, particularly in the two last editions of his 'Human Physiology,' a very full and detailed account of the further conclusions at which he has since arrived. It is frequently supposed that the spinal cord, if traced upward, communicates immediately with the cerebrum, so that actions and re-actions pass directly from the one into the other.



Side view of hemispheres of cerebrum and cerebellum.

This is shewn, by mere anatomy, to be erroneous. Instead of communicating with the cerebrum, the spinal cord is found to merge into a series of ganglionic masses, which form the centres of the nerves of sensation. These sensory ganglia are not, as was formerly supposed, mere appendages to the cerebrum; they are *distinct centres* of action and feeling, analogous to the entire 'brain' of insects and mollusks, and form, therefore, in regard to their functions, the subject of a distinct investigation, apart from the spinal cord on the one side, and the cerebral hemispheres on the other. It is in the fuller investigation of this second and intermediate centre of innervation, that Dr. Carpenter has added so materially to the elucidation of the whole subject of cerebral physiology. The 'sensory ganglia,' as Dr.



Sensory ganglia and cerebrum of human brain.

Carpenter has shewn, hold an intermediate position as regards their functions, as well as their location, between the spinal cord and the cerebrum. Like the intellectual and voluntary activity of the latter, their operations are connected with *consciousness;* but, like the reflex activity of the former, they take place without forethought, purpose, or any control of the will. From this peculiarity they have received the appellation of CONSENSUAL *actions.* Many simple examples of these actions might be readily cited. The start produced by a loud and sudden noise; the contraction of the eyelids, to prevent a too dazzling light; the act of sneezing, and the sensation of tickling; the process of sucking, in the young of the mammalia; these are a few of the most familiar instances of the consensual actions—actions, that is, bearing the double character of being attended with consciousness on the one hand, and yet being wholly involuntary on the other. They bear, it will be seen, a very close resemblance to the purely reflex actions before explained; and indeed may be called reflex, only with the further addition of our being fully conscious of their existence at the moment in which they take place. The most important conclusions drawn from the phenomena of the consensual actions, may be summed up as follows:—

"We learn from them—1. That many actions are performed by us, and performed *consciously,* which are not in any way the result of purpose, forethought, desire, or adaptation, and which therefore cannot be cited as any illustrations of our voluntary activity.

"2. That there exists in the mechanism of the ganglia a pre-arranged system of impulses, which urge us to the performance of various functions, adapted to answer important purposes in the physical economy of our being, independently of any thing connected with our own personal will or intelligence.

"3. A third conclusion is—that the sensory apparatus is that part of our nervous system which supplies the immediate force, not only for the actions above alluded to, but for *all kinds of voluntary action* as well; that the will itself, in fact, can only act upon the muscular system through its intervention; that every human action, accordingly, viewed at one remove, is really automatic, because the sensory ganglia operate upon the nerves belonging to the muscular system, in a mode of which we are wholly unconscious at the time, and impel them to certain results through an impulse blind in itself, although set in motion by a voluntary effort derived from the brain. This explains the reason why rapid actions are often performed by us with a view to certain ends, the individual movements of which we do not at all follow with the understanding and the will. The will only contemplates the desired end itself; the automatic action of the sensory nerves instinctively supplies the method of accomplishment.

"4. Another very important conclusion is—that the sensory apparatus, lying midway between the impulses of the world without, and the action of the intellect and will within, may be set into motion, and that similar motion, either by the one or the other. For example, a sensation, and the idea of a sensation, will often excite the very same consensuous movements. By thinking of a nauseous dish which has disgusted us, we may renew all the inconvenience we experienced from it. Many persons faint away by imagining vividly a surgical operation. The whole working, in fact, of the mind, and of its ideas upon the body, receives a new light as soon as we have well comprehended the independent position and the automatic action of the sensory ganglia. All the phenomena of hypnotism and electro-biology (as it is termed) are manifestly explicable on this principle. They all point to a great automatic centre, which can mould human action with the most perfect adaptation to definite ends, without being controlled by the will, and which may be excited, moreover, to do so either by impulses directly from without, or by strong ideas operating downwards upon it from within.

"5. One more point we may mention is—the light thrown by the consensuous movements upon the nature and philosophy of *instinct*. Those animals (chiefly insects) which are, as it were, all instinct, are known to possess simply a highly perfected sensory apparatus, without the super-addition of any cerebrum whatever, properly so called. Hence the rapidity, the perfection, the beauty, the adaptation of their movements, impelled, as they are, neither by conscious ideas nor by volition, but by a highly organised automatic machinery. The consensuous movements in man are exactly analogous to this. We perform involuntarily, and without reason or forethought, many actions which are as complex in their nature, and as curiously adapted to certain ends, as does the bee when it constructs its hexagonal cell, or the spider when it weaves its snares for its enemies. Thus nearly all the instincts, both of man and the lower animals, become, in fact, simple examples of the reflex action of the sensory ganglia."

[All the reasoning applied, by Dr. Carpenter, to the connexion of mind and body, applies, with equal force, to the connexion between life and body. We here see an elaborate system of organs, by which the life of the being is brought into contact with the external world. We find in the lower insects a nervous knotted chain, running through the body of the creature, and ministering to its sensitive actions: in ascending developement we notice a further display of nervous power, accompanied by an increased complexity of organic forms: but is not all this in obedience to that incorporate essence, which, included in the germ, manifests itself as an active formative power, building, as it were, the material fabric, subordinating material forms to its own use, and for its own ultimate good? Not that this life-power is itself capable of originating or changing its form or nature, but that, in obedience to laws or impulses, or capacities imparted to it from the beginning of its creation, it moves and appropriates, and subordinates to itself, all that its Creator intended that it should, and which it will continue to do until his will is re-called. Organs and instruments it apparently must have, under its present existence; but we hold it contrary to reason and sound argument, to confound the life with the organism, or to locate in any one organ, that which has been united as a great whole—for, that the union is real, even Dr. Carpenter seems to admit, for he says, "we are led to perceive, that as the power of the will can develope nervous activity, and as the nerve-force can develope mental activity, there must be a correlation between these two modes of dynamical agency;" a correlation we hold so real, that we can no more separate them than by severing the head from the trunk and the trunk from limbs—the disjointed members could be taken as the living man.]

"These, then, are some of the conclusions which have been drawn from the physiological investigation of this portion of our nervous system. Much more will undoubtedly be elicited in process of time; but what we have already presented sufficiently proves that, in any analysis of our complex mental phenomena, we should be liable to many errors and false conclusions without the light that flows from cerebral physiology; and that, in investigating a large number of important facts, we derive an essential service from the knowledge now possessed of the independent action of the reflex and the consensual centres of human activity.

"Whether a similar light will be thrown upon the working of the emotions, remains to be seen. In the highly intelligent and scientific work of Mr. Noble on Insanity, we are directed to a series of physiological facts bearing very closely upon the elucidation of this part of our nature. He has there stated various grounds for the belief, that the emotional sensibility has a distinct centre amongst the ganglia of the lower brain; and shews that by well adapted experiments and observations we may succeed eventually in isolating, as it were, the activity of the emotions, just in the same way as Dr. Carpenter has done with regard to the sensory apparatus. If this theory be verified, we may expect a new and most welcome light to be shed, through the aid of physiology, accompanied by a series of well-directed experiments, upon that portion of our mental constitution, which has hitherto been marked, even amongst professed psychologists, with the greatest amount of indistinctness and confusion.

"To return, however, from this short digression on the emotions, we must proceed somewhat further with our exposition of the various centres of nervous action. Two have already been pointed out; those which originate purely reflex and unconscious movements; and those which give rise to conscious but yet involuntary actions, prompted by certain guiding sensations. It is hardly necessary now to dwell at any length upon the third great centre of innervation, which exists in the cerebrum proper. All the experiments of modern physiology go distinctly to prove that the physical organ attached to the intellect and the will lies here. This third centre of nervous action, moreover, operates in perfect co-ordination with the other two. Just as an impulse from without passes upwards, first through the spinal cord, then to the sensorium, where it becomes an object of consciousness, and lastly, to the cerebral hemispheres, and is there attended by the genesis of actual ideas; so an idea or volition, beginning its physical career in the brain, passes down again to the sensorium, sets the automatic apparatus in motion, and finally reacts, through the instrumentality of the muscular system, upon the world without; the whole system thus shewing the most beautiful and harmonious co-ordination between thought itself, the material organism through which it is conveyed, and the order of universal nature in the midst of which we are placed.

"We may regard it, then, in fine, as a point in our knowledge of humanity which has been definitely gained by the researches of modern physiology, and which can now be set down within the region of positive fact,—that there are *three main centres of nervous action*—the spinal cord, or the excitor-motor system; the sensory ganglia, or the consensuous system; and, lastly, the cerebrum proper, which is now known, as far as any direct evidence can reach the case, to be the physical laboratory in which our notions, ideas, and voluntary efforts first manifest their action on the world without.

"In the 'Elements of Psychology,' by J. D. Morell, these conclusions, which have been recently developed on the side of physiology, are employed for *generalising* the study of mental philosophy, and bringing it more directly into co-ordination with the science of nature. The views there presented are substantially as follows. Comparative physiology has brought to light the fact that, physically speaking, *there is a regular progression visible throughout all organised existence.* The vegetable world exhibits already the phenomena of life and growth—*i. e.*, of self-developement from a primary germ in the way of cell-formation. Proceeding upwards, we find that the limits between the vegetable and the animal kingdom can hardly be defined; and that when we once arrive definitely at the lower forms of animal life, there is still an infinite gradation in the structure and perfection of the nervous system, developing one instinct and one faculty after another, till we come to the very limits of humanity. Once within the region of humanity, we see the law of progress still going forward, and exhibiting a new series of stages, from the mere sensitive life of the infant, up to the loftiest forms of reason and will.

"If, then, we can trace a regular progression throughout nature, in carrying out the laws of organic life—from the first effort at cell-formation up to the highest and most complicated cerebral machinery—then, it is argued, there must be some rational connexion running through the whole. This connexion is seen in the fact, that there is a constant tendency throughout all being to advance from the more material form of existence to the more immaterial; from the more instinctive regions of intelligence to the more rational; from the passive to the active; from the dependent to the independent; from complete identification with nature to the higher life of a self-determining individual. This law, then, which we see at work throughout nature universally, holds good equally in the whole process of our mental developement. The principle of life, which acts unconsciously, though with perfect adaptation, in the vegetable world—which operates blindly, according to mere instinct and impulse, amongst the lower animals—which gives rise, not only in them, but also in mankind as well, to reflex activities beautifully adapted to subserve the purposes of self-preservation,—*this principle of life is* *at length gifted with self-consciousness in connexion with the superior organism of the brain, and the consequent operation of the higher faculties;* and being gifted with self-consciousness, still proceeds onward to the developement of the highest reason, the purest emotions, and the most perfectly self-regulating will. The problem of psychology, accordingly, as here viewed, is to shew how the laws of nature, assuming the form of the laws of self-conscious mind, accompany the soul onwards through the various regions of instinct, of sensitivity, of intuitive perception, of ideal representation, &c., up to the highest regions of reflective thought and voluntary activity. In this way mind comes to be viewed as an organic unity, developing successive powers like every other organism; and *the science of mind*, no longer standing alone, takes its place in the regular series of the natural sciences, depending for its data upon the results of those which have gone before.

"This point of view has been taken up by Dr. Laycock, and made the basis of renewed investigations into the functions of the brain. Starting with the now admitted phenomena of reflex action, and granting that such action must take its rise from the vesicular matter of which the ganglia are composed, he goes back one step further in the enquiry, and asks, How or by what active principle is it that this vesicular organism is constructed, and so constructed as to produce such marvellous results? How is it that a material machinery should exist within us which, when set in motion by some stimulus from without, should have all the effect of the most perfect contrivance and forethought? What is the principle of intelligence by which it acts, independent as it is of our own conscious volition? Theories of all kinds, he shews, have been formed in reply. Plato, in his time, maintained the existence of a *plastic power* in nature, which forms every thing adaptively for its position and circumstances. The ordinary way of cutting the knot at present is by introducing a *Deus ex machinâ* and attributing the constructive power and intelligence shewn both in the mechanism and functions of the ganglia and nerves, to the direct, separate, and individualised operation of the Deity; which comes, in fact, to a sort of modified doctrine of '*occasional causes.*'

"With these hypotheses, however, Dr. Laycock thinks *inductive philosophy* has nothing to do. It treats only of palpable phenomena, and the method of their operation. It seeks to find some expression of the laws of nature actually at work around us, independently of any theory respecting the individual exertion of Divine power in carrying them on. Viewing the subject in this light, one plain fact presents itself to us, that there is inherent in the primordial cell of every organic existence, and through all its subsequent growth, *an immanent or abiding law of developement*, which moulds matter into forms of the most exquisite beauty, and constructs out of it machines adapted to all the peculiar wants or possible contingencies of the individual. Speculation may account for this abiding law of plastic activity in a variety of ways: there may be, and have been, numerous theories as to its exact relation to the great First Cause, the all-sustaining Mind of the universe; but apart from speculation, here is the fact palpably presented to us, that a principle of life exists, and exists abidingly, in the primary cell and its subsequent developement, which acts at every instant of each creature's organic growth, and acts, too, with all the effect, all the outward manifestation, and all the final results, of intelligence—that is, of complete adaptation of means to the most desirable ends. Whether we choose to call this a principle of intelligence or not, must, of course, depend upon our definition of the term—*i. e.*, whether or not the word 'intelligence' ought to be employed for any kind of activity which is unaccompanied with self-consciousness. That there is a principle at work, however, in every atom of organised matter which produces intelligent *results*, is a fact which, speculation apart, admits of no dispute.

"Having considered the plastic principle that resides in every organism, Dr. Laycock next goes on to shew that there must be a direct connexion between the construction of organisms, and their use when constructed; and that we have no right, on the principles of the inductive philosophy, to wander away into speculations, and imagine two distinct intelligent agents, to account for these two so closely affiliated purposes. The intelligence, for example, that developes the ganglia in the head of the bee from the primary insect cell-germ, must, he thinks, be fundamentally the same as that which prompts it to construct a comb with the most perfect mathematical proportions. Either we must attribute both processes to an extraneous power, which renders the bee simply a living machine, or we must attribute them both to an immanent principle, that operates without self-consciousness, indeed, yet individually, in each separate organism.

"The operations or functions, then, of what we may term the *unconscious principle of intelligence* in organic nature, may be summed up in a few words: —1. It moulds matter into living organisms according to a fixed, pre-determined plan, and yet adapts them by the most certain intuitive logic to the purposes for which they are constructed. 2. It moves and regulates these living machines, according to fixed and unchanging sequences, in such a way as to promote the welfare and continued existence of the individual. 3. In animals endowed with self-consciousness—that is, in man—it acts upon the vesicular matter of the brain, and excites changes there; the results of which changes, when presented to the consciousness, constitute some of the most important phenomena of thought.

"The next step, according to Dr. Laycock (after this elucidation of what he has termed the unconscious principle of intelligence), is to shew the relation which this unconscious principle bears to the conscious mind. Are we to regard them as two distinct intelligent agents; or can we identify them as being really and fundamentally one and the same? To this question Dr. Laycock has addressed himself at some length, and shews with great skill that it is impossible to separate into two categories the ganglionic formations, which subserve the *instinctive* life of men and animals, and the cerebral formations, which subserve *conscious intelligence.* He has proved, in fact, that the brain is, strictly speaking, a large ganglionic centre, only superior to the rest; that it is subject to the same laws of developement and growth; that it accumulates substrata, and, consequently, power of function, in the same way as the rest of the nervous system; that it responds to stimuli in the same manner, and is strictly subject to reflex actions;—in brief, 'that the two forms of mental manifestation—the voluntary and the involuntary—have a common origin and a common substratum, and *that the human mind is none other than the unconsciously working principle of intelligence individualised, become conscious of its own workings in the cerebrum, and deriving its ideas from its own constructive or material changes in the organ of mind.*'

"In the views thus put forward by Dr. Laycock, we certainly see the most complete co-ordination established between psychology and physiology in the widest extent. All the facts and laws of physiology, beginning with the simplest notions of cell-formation, are brought into play, and then traced upwards in one direct line of progression, till we are landed amidst the most remarkable phenomena of mind and the general laws of its operation. Whether all the particular conclusions which Dr. Laycock has drawn, in his analysis of the subject, are correct, it can hardly be our object here to examine. The point we are most anxious to notice is, the new direction which this kind of research must inevitably give to psychology as a science, in extending the operations of mind beyond the limits of consciousness, and thus drawing the activity of the soul and the activities of nature into one broad and scientific generalisation. Doubtless, it will require both time and labour to work out this generalisation, but no system of psychology can henceforth prove satisfactory that does not at least *attempt* to solve the problem thus arrived at, and to interpret the numerous phenomena which bear so directly upon it.

"When all the direct correspondences of the soul and the world shall have been explored, we shall not then be at the complete termination of our research; for our enquiries lead us insensibly onwards to the primary cause as well as the final goal of human reason, and to the problem of human destiny, in connexion with that great all-pervading Intelligence by which the pre-established order of the conscious and unconscious universe has been itself arranged from the beginning. If intelligence grows and expands through the perpetual adjustment of mind with nature, then must it not reach up at last to that primæval Intelligence by which the law of life has been planned and sent forth upon its mission? And if we can identify instinct as the early twilight of reason, cannot we follow out the same law of progress, so as to identify human reason itself in its present form as the twilight only of a still higher form of existence? These are questions to which psychology at present only distantly and indistinctly points us; but strange indeed would it be if the more complete comprehension of mental phenomena should be found ultimately destructive to the best aspirations and the most purifying faith of our spiritual nature. For ourselves, we believe that while it sweeps away many narrow and noxious superstitions, it will leave the great pillars of our moral conviction and our human hopes more firmly than ever rooted in the analogies of reason, and the obvious tendencies of human life."

How different is the foregoing from the doctrine of Dr. Carpenter—"admit that there is a peculiar substratum, necessary for the manifestation of special forms of force;" or, with Dr. Williams, that "there is some mysterious relation between the *shape* and *the substance*, between the *material* and the *form*;" yet we must still have an incorporate principle, an essence which is not matter, but yet dwells within matter: we must, too, keep in view the fact that it is with the *whole nature* of the being that we have to deal, and not with isolated portions of that being; and, speaking of man, it is the whole man—body, soul, and spirit—that we must include in our reasoning, as to his nature and connexion with the world. That Dr. Carpenter has mis-stated the case, and altogether ignored the independence of life, and identified it with other forces, is evident enough from the language employed by Dr. Williams, and already referred to; and it is on this very account that we are the more desirous to endeavour to discover the truth, and set it in its true light. In the first place, we may direct attention to the fact, that there is a very great difference between the correlation of forces, and the "convertibility of forces;" and yet this is the very complication into which the question has been thrown. Now no one could have been more particular or guarded in his language than Mattenci, who has wrought out so much for us in this branch of scientific enquiry; and how do we find him stating the doctrine? In speaking of nerve-force, he says, "This unknown force of the nervous system is, therefore, *not electricity*, and still less is it the electric current. But what connexion exists between it and electricity, or the electric current?

In order to reply to these questions, we may sum up, that there exists, between electricity and the nerve-force, an analogy which, if it does not possess the same degree of evidence, is, however, of the same kind as those analogies which we know to exist between caloric, light, and electricity. We have seen, when speaking of the phenomena presented by electric fishes, that the faculty which they possess of producing electricity, is obedient to the nervous system. There is, then, in those animals, *a peculiar organic structure*, such an arrangement of parts, that, by an act of the nervous force, they can develope the electric fluid. A crystal of tourmaline, *when heated*, developes electricity and from this fact we assume that between caloric and electricity there exists a more or less intimate relation. The phenomena which we have observed in electrical fishes, prove that a link of the same nature unites the nervous force and electricity. Electricity *is not* the nervous force, *nor is* caloric electricity. The latter is derived from caloric, in consequence of the form of the integral molecules of the tourmaline; (?) the nervous is transformed into electricity, under the influence of the peculiar structure of the organs of the electric fishes. We conclude, therefore, that the great physical agents, caloric, light, electricity, and molecular attraction, *act* on *living beings* as well as on all bodies of nature, and that their action must necessarily be influential in the production of the functions peculiar to these beings; that these forces, when acting on organised matter, *have their general mode of action modified*, and that this difference is owing to a diversity in the structure and mechanical composition of organised bodies; THAT THERE IS ALSO IN LIVING BEINGS phenomena, which we call VITAL; that these are numerous and of the highest importance, and that in the present state of science we are unable to explain how their production can be influenced by physical agents, *though the action* of these be modified by the organism.

Do the observations and experiments, on which the doctrine of the "convertibility" of force rests, warrant the conclusions to which our authors have come? We will endeavour to discover.

We may briefly allude to the account of the action of light on the vegetable germ, as detailed by Dr. Carpenter, and as also given by Prof. Draper:—"If we expose some spring water to the sunshine, though it may have been clear and transparent at first, it presently begins to assume a greenish tint; and after awhile flocks of green matter collect on the sides of the vessel in which it is contained. On these flocks, whenever the sun is shining, bubbles of gas may be seen, which, if collected, prove to be a mixture of oxygen and nitrogen, the proportion of the two being variable. Meanwhile the green matter rapidly grows; its new parts, as they are developed, being all day long covered with air-bells, which disappear as soon as the sun has set. If these observations be made upon a stream of water, the current of which runs slowly, it will be discovered that the green matter serves as food for thousands of aquatic insects, which make their habitations in it. These insects are endowed with powers of rapid locomotion, and possess a highly organised structure; in their turn they fall a prey to the fishes which frequent such streams." Such is the general succession of nutritive actions in the organised creation. The highest animal is either directly dependent upon the vegetable kingdom for the materials of its fabric, or it is furnished with these by some other animal, this again (it may be) by another, and so on; the last in the series being *always* necessitated to find its support in the vegetable kingdom, since the animal does not possess the power of causing the inorganic elements to unite into even the simplest organic compound. This power is possessed in a high degree by plants; but it can be only exercised under the influence of *light*, which is, therefore, the prime agent on which all the phenomena of life depend.

"The green matter of Priestley, which makes its appearance when water of average purity is submitted to the action of the sun's light, and which also presents itself on the surface of walls and rocks that are constantly kept damp, is now known by botanists to consist of *cells*, in various stages of developement,—the early forms, it may be, of several different species of confervæ. *That these cells all originate from germs*, and *not* from any *direct combination* of the inorganic elements, appears not only from general considerations, but also from the fact that, if measures be taken to free the water entirely from any possible infusion of organic matter, and to admit into contact with it *such air alone as has undergone* a similar purification, no green flocks make their appearance, under the prolonged influence of the strongest sun-light. *We find, then, that the presence of a germ is one* of the conditions INDISPENSABLE to the new production in question." And to this conclusion every physiologist has at length satisfactorily arrived; we have, therefore, two great facts admitted, first, the necessity of their being present not only "a germ," but a *living germ*, on which light may act; second, that each kingdom of nature is related the one to the other, although they are also independent.

With regard to the action of light on organisation, it may be legitimately stated that, so far from its action being modified, we, on the contrary, from direct experiment, ascertain that, of the agents of which it is composed, some would appear to exercise a special influence on the growth of plants, and, no doubt, on animals; while others are destined for the purposes of vision, &c., &c. It is, therefore, undoubtedly true, that light, as a force, or some of its elements, are necessary to enable the germ of an organised being to develope itself; but is it true that the "yellow ray, falling on this germ, is so modified as to be *converted* into life," by the substratum through which it passes. We have already shewn that there is no reason whatever for receiving this doctrine.

Reverting to the illustration which has been given by Dr. Carpenter, viz., "that force A., operating upon a certain form of matter, *ceases* to manifest itself, but B. is developed in its stead;" and, as an example, states the circumstances attendant on the states which water assumes under different degrees of temperature. If we analyse the phenomena and interpret them truly, we shall not be content, it is believed, to use the expression "developed in its stead;" on the contrary, we can only legitimately say, "another mode of force is induced;" thus, we may take as examples, the metals lead and iron, and the liquids water and bi-sulphuret of carbon, and the gases which have been liquified.

In taking the solids into consideration, it will be admitted that they are fused at different temperatures, but the same solid is *always fused* at the *same* temperature. In the same manner, all liquids which, by the loss of heat, are converted into solids, have a certain point—*the same* for each liquid, but *different* for different liquids—at which they pass into the solid form. If we take the experiments already prepared for us, and very succinctly narrated by Dr. Lardner, we have apt illustrations of the phenomena at once, although we cannot accept the explanation which he offers. "Let us suppose that a mass office or snow, at the temperature of 20°, is placed in a vessel and immersed in a bath of quicksilver, under which spirit lamps are placed. Let one thermometer be immersed in the ice or snow, and another in the mercury. Let the number and force of the lamps be so regulated, that the thermometer in the mercury shall indicate the uniform temperature of 200°. The mercury imparting heat to the vessel containing the ice, will first cause the ice to rise from 20° to 32°, which will be indicated by the thermometer immersed in the ice; but when that thermometer has risen to 32°, it will become stationary, and the ice will begin to be liquified. This process of liquifaction will continue for a considerable time, during which the thermometer will continue to stand at 32°; at the moment that the last portion of ice is liquified, it will again begin to rise." The coincidence of this elevation with the completion of the liquifaction may be easily observed, because ice being lighter—bulk for bulk—than water, will float on the surface, and so long as a particle of it remains unmelted, it will be visible.

"It is evident," remarks Dr. Lardner, "that during this process, the mercury maintained at 200°, constantly imparts heat to the ice: yet, from the moment the liquifaction begins, until it is completed, *no increase of temperature* is exhibited *by the thermometer immersed in the ice.*" Mr. Grove refers to this illustration in support of his opinions. But what is evidently the true interpretation of the phenomena, for certainly Dr. Lardner's account is by no means satisfactory, nor do we believe Mr. Grove's to be more so.

In order to give a correct explanation, we shall first refer to the table of diathermanous bodies; there we learn that of all liquids, water is the least diathermanous, and water in a state of congelation much less so than in the liquid state. Now it cannot be said that the mercury, maintained at 200° constantly, imparts heat to the ice, *i. e.*, in the sense used by the author; for it is to be borne in mind that the imparted heat *does not* penetrate *the lump or mass of ice*, but acts only on the surface, so that not a single atom of heat, or, rather, the rays of heat do not reach the thermometer *until liquifaction has actually taken place.* We have, therefore, to look to the *melted ice* or *water* for the amount of imparted heat said to be rendered latent,—recollecting that frozen water is diathermanous—refusing to admit the rays of heat through its frozen mass. We can have no difficulty in shewing that the particles have not been in a state of repulsion in the area of the thermometer; but not so with the water, which has collected in the liquid form from the surface of the ice. This is proved by another experiment. "Let us suppose that a vessel, containing water at 60°, is immersed in a bath of mercury at the temperature of 60° below the freezing point. If one thermometer be immersed in the mercury, and another in the water, *the former* will gradually rise, and the latter fall, until the latter indicates 32°. This thermometer will then become stationary, and the water will begin to freeze; meanwhile the thermometer immersed in the mercury will still rise, proving that the water—while it freezes—continually imparts heat to the mercury, although the thermometer immersed in the freezing water does not fall. When the congelation is completed, and the whole quantity of water is reduced to the solid state, then, and not until then, the thermometer immersed in the ice will again begin to fall. The thermometer immersed in the mercury will rise without interruption, until the two thermometers meet at some temperature below 32°." Here we have the one thermometer immersed at a temperature of 60° or 31° above freezing, while the second is in the mercurial bath (itself containing the water bath) at 60° below freezing; the consequence is, that the one which is in the mercury will rise, while the one in the water falls until it registers 32°, the freezing point of the water, when it ceases to fall; but the other thermometer still rises. Now in this case we cannot understand how what is called latent heat explains the phenomena ; on the contrary, we rather think that *latent* heat has nothing to do with it, and the whole answer is contained in the relative capacity of the two liquids for heat, their conditions being the same, *i. e.*, both being exposed to the same atmospheric pressure. Water, at the temperature of 32°, changes from the liquid to the solid state, particularly if it be subjected to the slightest agitation ; although, as the thermometer shows, if the water be perfectly still, a lower temperature, and therefore less heat, will be amongst its particles. Mercury has a much larger range, freezing at 40° below zero, and boiling at 662°. It is highly sensitive to change of temperature, dilating with promptitude by the same increments of heat with great regularity, and a smaller quantity of heat produces in it a greater dilatation than in most other liquids. It is evident, therefore, that as water freezes at 32°, assuming the solid form, and being the least diathermanous body, the thermometer which *rests on it* will not fall below 32°, for the volume of water around the ice, which *has not yet* frozen, is still imparting heat to the mercury, as the thermometer shews. When the heat has passed *from the water* in the trough, sufficiently to reduce the *whole* to the *state of ice*, then, and not till then, will the thermometer on the ice begin to fall a second time ; for the simple reason that the temperature throughout the mass of ice—now one homogeneous solid—is the same, and the actual heat which is in it, measured at 32°, passes still on to the mercury, which will continue to abstract it, (as it does not freeze many degrees yet lower,) until both thermometers stand below 32°. How this case can be taken as an illustration of the latency of heat, we cannot conceive. But neither can it, we believe, be put forward as an illustration of the doctrine of the *convertibility* of forces. Again, referring to the order in which the phenomena succeed each other, we find that water, under a certain degree of pressure, at the temperature of 32°, passes from the liquid to the solid state. Experiment further declares that, at the temperature of 32°, there is yet remaining in the solidified water or ice, a further quantity of actual heat, provided that the ice be in contact with a body colder than itself. At the temperature of 32°, therefore, in the case of water, the quantity of heat now surrounding the particles of water is not enough to maintain their repulsion as a liquid, consequently they undergo a change somewhat like crystalization: if it be so, and the whole assumes the solid form, the presence, then, of *new forces* has hence been necessitated or induced, without the original force having departed or been changed; for we first have *motion* amongst the particles of water, on the reduction of the heat to 32°, and then congelation; yet we must recollect that heat is still present in the ice, and may be even further withdrawn below 32°. Hence it is we infer that a relationship does really exist amongst the respective forces, which are nevertheless distinct; and that although it may be true that, in some cases, one force may take the place of another, yet, as a general rule, it may be said that one force necessitates the presence of another, or even of more forces. Mr. Grove views heat simply as "a molecular repulsive power," which is communicable by contiguity or proximity.

Without going too far into an examination of this question, we may cite the very beautiful and instructive experiments of Prof. Draper, "on tithonized chlorine." "In two similar white glass tubes place equal volumes of chlorine, which has been made from peroxide of manganese and muriatic acid, by lamp-light, and *carefully screened from access* of day-light. Expose one of the tubes to the full sunbeams for some minutes, or, if the light be feeble, for a quarter of an hour; the chlorine which is in it becomes tithonized. Keep the other tube, during this time, carefully in a dark place; and now, by lamp-light, add to both equal volumes of hydrogen gas. These processes are best carried on in a small porcelain or earthenware trough, filled with a saturated solution of common salt, which dissolves chlorine slowly, and, to avoid explosions, operate on limited quantities of the gases. The two tubes now contain the same gaseous mixture, and only differ in the circumstance that one is tithonized, the other not. Place them, therefore, side by side before a window, through which the entrance of daylight can be effected by opening the shutter; and now, if this part of the process be conducted properly, it will be seen that the tithonized chlorine commences to unite with the hydrogen, and the salt water rises in that tube. But the untithonized chlorine shews no disposition to unite with its hydrogen, and the liquid in its tube remains motionless for a long time. Finally, as it becomes slowly tithonized, by the action of the daylight impinging on it, union at last takes place. From this, therefore, we perceive that chlorine, which has been exposed to the sun, will unite promptly and energetically with hydrogen; but that chlorine, which has been made and kept in the dark, shews no such property." This effect is not transient. We must divest the mind of the impression that heat is in itself a substantial reality, when we find such qualities resulting from it; for we have here the matter of space in a heated state--and we so far differ from Prof. Draper's opinion—as to their being any absorption of the tithonic rays, that we imagine that the phenomena may be much more satisfactorily explained by referring them to the action of catalysis. The more we examine the illustrations Mr. Grove has given, the more conclusive does his reasoning appear: he says, " the effects of what we call heat are simply an expansion of the matter acted on, and the matter so expanded has the power of communicating expansion to certain other bodies in contiguity to it—if the body be a solid, iron; a liquid, water; or a gas, say atmospheric air—each of these passing into the heated state, is expanded in every direction: in the two former cases, by continuing the contact or contiguity for a certain time, a change is produced in the physical character of the substance, the solid becomes liquified, the liquid may be vapourized, &c., &c. These, however, are still nothing more than instances of expansion, and, in the case of a gas, and water also, the expansion becomes rapidly and indefinitely greater. Now what is, in fact, done, in order to heat a substance? It is merely approximated to some other body that is in a heated state: but, in order to continue this condition, it is essential that the body continue in that state, and in proportion to the expansion or motion is the manifestation of the phenomena of heat; and thus we find heat and motion co-existing. We certainly fail to discover any thing in the behaviour of heated bodies which gives any real support to the very novel theory of conversion; and thus, when we appeal to another source for information—an organised body—we receive even more convincing arguments against it. The seed, for example. We have most of us either seen or heard of wheat raised from grains taken from the hand of an

Egyptian mummy. What preserved those grains from decay? We answer, the fact of its containing within itself—as part of the very essence of its constitution—the power—life—the capacity to develope and to display vital phenomena —a power and capacity implanted in its substance and form at the very instant of its creation. The late illustrious British philosopher, John Hunter, whose acute perception enabled him to grasp almost intuitively the most complicated problems of natural history and physiology, long ago pointed to the egg as illustrative of the fact that the phenomena which we denominate vital, are given to certain forms of matter in a general and special manner; and he clearly recognised the relationship which exists between vital and physical forces, and of these, particularly motion. His remarks on this point, made at so comparatively remote a period, would no doubt be hailed by Mr. Grove as particularly advantageous to his views. And, indeed, so late as 1835, Mr. Palmer, editor of Hunter's works, observed that "it is considered by many, and perhaps truly, that we are not yet prepared for a generalisation of so high a kind, or, at least, that it would be more convenient for the analysis of vital phenomena to consider life as made up of several principles, differing in their nature." And a second note, added by Mr. Palmer, still further shews how certainly Mr. Hunter had anticipated physiologists in the doctrine of "a general vital force," or, "the unity of the principle of life," the modifications of life being *accompanied by a differentiation of the organism.* "All matter," observes Mr. Hunter, "is endowed with a principle called, in common language, *life.* This principle is conceived of with more difficulty than any other in nature, which arises in its being more complex in its effects than any other; but although life may appear *very compound in its effects in a complicated animal like man, it is as simple in him* as in the most simple animal, *and is reducible to one* simple property in *every animal.* Animal matter may be in two states; in one it is endowed with the living principle, in the other it is deprived of it. From this it appears that the principle called life *cannot arise* from the peculiar *modification* of matter, because the same modification exists where this principle is no more. Life appears to be something superadded to this peculiar modification of matter; or this peculiar modification of matter is so arranged that the principle of life arises out of the arrangement, and this peculiar disposition of parts may be destroyed, and still the modification from which it is called animal matter remain the same. If the latter be the true explanation, this arrangement of parts, on which life should depend, would not be that position of parts necessary to the formation of a whole part or organ, for that is probably a mechanical, or, at least, organical arrangement; but just a peculiar arrangement of the most simple particles, giving rise to a principle of preservation, so that matter so arranged could not undergo any destructive change till this arrangement was destroyed, which is death.

"This simple principle of life can with difficulty be conceived: but to shew that matter may take on new properties, without being altered in itself as to the species of matter, it may not be improper to illustrate this idea by such acquirements in other matter. Perhaps magnetism affords the best illustration we can give of this. A bar of iron without magnetism may be considered like animal matter without life: set it upright, and it acquires a new property, of attraction and repulsion, at its different ends. Now is this any substance added? or is it a certain change which takes place in the arrangement of particles of iron, giving it this property? *It was not sufficient* that animal matter should be endowed with this first principle—the principle of preservation—it was necessary that it should *have action* or *motion within itself*. This does not necessarily arise out of the arrangement for preservation; on the other hand, the arrangement for preservation, which is life, becomes the *principle of action*—not the *power* of action—for the power of action is one step further. The *power of action* must arise from a particular position of those living parts, for, before *action* can take place, the matter must be arranged with this view. This is generally effected by the union of two or more living parts, so united as to allow of motion in each other, which motion the principle of action is capable of effecting when so disposed. A number of these simple acting parts make, united, a muscular fibre: when a number of these are put together they form a muscle, which, joined with other kinds of animal matter, as tendon, ligament, composes what may be called an organ. Then, too, by the arrangement of living particles, the other organs of the body are formed, their various dispositions and actions depending on the nature of the arrangement, *for action* is not confined to muscle; the nerves also have action, arising *from the arrangement of the living particle*. The principle of life has been compared to a watch or the moving powers of other machinery; but its mode of existence is entirely different. In a machine, the power is only the cause of the first movement or action, and thereby becomes the remote cause of the second, third, &c.; but this is not the case with an animal; animal matter has a principle of action in every part independent of the others, and whenever the action of one part—which is always the effect of the living principle—becomes the cause of an action in another, it is by stimulating the living principle of that other part; the action in the second part being as much the effect of the living principle of that part, as the action of the first was of the living principle in it.

The living principle, then, is the immediate cause of action in every part; it is, therefore, essential to every part, *and is as much the property of it as gravity is of every particle of matter composing the whole.* Every individual particle of the animal matter, then, is possessed of life, and the least imaginable part which we can separate, is as much alive as the whole. A fresh egg is a body which, it must be allowed, has no vital action; yet an egg is as much alive as an animal; thus, I observed, that whenever an egg was hatched, the yelk which was not diminished in the term of incubation remains sweet to the last, and that part of the albumen which was not employed in the growth of the chick, was perfectly sweet some days before the hatching, though both had been kept at a temperature of 103°, in a hen's nest, for three weeks. But if the egg did not hatch, it became putrid in the same time that other dead animal matter does. These observations, made by Mr. Hunter, nearly a century ago, certainly seem to be much nearer the truth than the doctrines advanced by his successors, and, coupled with those which have been very lately put forth by Dr. Laycock, are exceedingly valuable; and, as Dr. Laycock no where alludes to Hunter's opinions, we may reasonably conclude that his opinions have been formed independently. We can discover no difference between the great father of British surgery and anatomy—who declared "life" to be as simple in man as in the most simple animal, and "that it is reducible to one simple property in every animal,"—and the Edinburgh Professor, who declares that "The principle of life, which acts unconsciously, though with perfect adaptation in the vegetable world; which operates blindly, according to mere instinct and impulse, amongst the lower animals; which gives rise, not only in them, but also in mankind as well, to reflex activities, beautifully adapted to serve the purposes of self-preservation. That *this principle of life* is at length gifted with self-consciousness, *in connexion with* a superior organism of the brain, and the consequent operation of the higher faculties: and being gifted with self-consciousness, still proceeds onwards to the developement of the highest reason, the purest emotions, and the most perfectly self-regulating will."

Later observations very strongly confirm these views, for Dr. Williams, of Swansea, remarks that "In the animal series, the fluids and the solids exhibit a never-varying relation to each other. Where the machinery of the latter is of low standard, the former is simple in chemical and vital composition. As new organs are added to the organism in the zoological series, so new principles or elements are developed in the fluids, and conversely as the scale is descended. This proposition was discussed at length in former papers. Of course it is not given as an unexceptionable rule. Thus expressed, it may probably, as details of structures are more and more amassed by special and improved observation, come to wear too absolute a form. It was then stated that, in going down the series, the disappearance of an organ, or a system of organs, from the solids, implied necessarily the cessation in the fluids of those products which such an organ or system was designed to elaborate. But another method of descensive simplification was then also explained. It was shewn that even the ultimate histological elements grew more and more simple. This idea is supported by the history of the muscle and nerve tissue in the scale. It is self-evident that the bile of an annelid or an echinoderm cannot be so complex a fluid as the bile of a mammal; because, first, the biliary organ in the former instances, by which that bile is secreted, is more simple than it is in the latter; and secondly, because the fluid from which that organ draws the product of its action is more simple. This argument applies with equal force to all the solid systems of the body. As the animal chain is histologically traced downwards, it is found that the higher class of tissues disappear more and more, and that the less endowed elements acquire a greater and greater predominance in the organism. Of the *general* truth of these views, thus recapitulated after much subsequent study and observation, the author is still convinced.

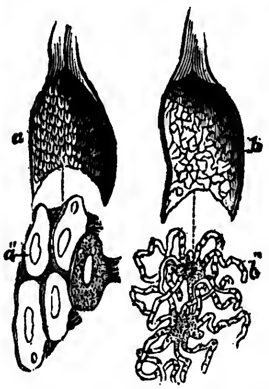
"The system of the fluids does not constitute, in the zoological series, an independent chain. A study of this system, apart from its connexions, would lead to no useful results. Viewing it in its reciprocal relations with that of the solids, an intelligent observer cannot ascend or descend a step without acquiring a new idea or seizing a new principle. The fluids act and are acted upon ; this is also true of the parenchyma. The reciprocity is an endless tangle. No one point more than another can be signalised as the beginning or the end of a succession. This difficulty renders the present enquiry both long and involved.

"Out of one common source—the fluids—different solids are moulded in the lowest as in the highest organisms. In this process of appropriation the fluids are passive, the solids are active and positive. (?)*

Take corresponding parts of the same organ from ascaris lumbricoides of the sheep, and note the extraordinary fact that beneath an exterior of perfectly similar conformation there lies a singular histological difference. "The testis of the male has the same general conformation as *one* of the tubular ovaries of the female. Both commence in a slender cæcal tube, which slowly grows larger and thicker until it reaches a dilated portion, which in the female is the uterus, fig. 14 *a* (Nelson) ; Eiweiss-

* This is pure assumption, for there is reason to believe that both fluids and solids are, as living structures, active and positive; the history of excretion and secretion proves this, and the preceeding paragraphs by Dr. Williams.

schlauch (Meissner); in the male, the vesicula seminalis (Nelson), fig. 15 *b*. Dr. Nelson has most accurately described the female organ, but neither he nor Meissner alludes to the following interesting peculiarity in the structure of the male organ. If the *lining membrane* of the male and female organ be compared *stage for stage*, commencing at the fine cæcal end, and ending at the dilated portion, it will be found that at the first stage (that at which the germinal vesicle is formed in the female, the nucleus of the sperm-cell in the male) the *mucous or lining membrane* is precisely the same in both; at the second (corresponding with the "Dotterstock" of Meissner, and the Vitellarium of Nelson) the lining cells of the membrane in the female tube have increased in size, but are still oval in form, having a very conspicuous nucleus; in the male tube they have a very distinct pyriform shape, being attached to the sides of the tube endwise, forming thus a villous coating; at the third stage (uterus, Nelson; Eiweiss-schlauch, Meissner) the two series of cells are found to have diverged from each other to a remarkable degree (compare *a''*, fig. 14, with *b''*, fig. 15). In the female series (*a''*, fig. 14), the cells have deviated little from their original form; they are still large elliptical bodies, having a very evident clear nucleus in the centre, the space between it and the involucrum being filled with granules. In the male tube, at the same stage, the cells have acquired an extraordinary spider-like form. The nucleus is so small as scarcely to be detected, but the membrane of the cell-wall (b'', fig. 15) has thrown out singular pseudopod-like processes, which, when the cells are ***in** situ*, mat themselves together into a thick felt with those of the adjoining cells. These processes are *hollow*, and contain the same granules as those which are seen in the centre of the cell. Higher up in the tube they are projected only from *one side* of the cell. Thus, as the generative tube is traced downwards, they gradually grow from the pair-like into the crab-like form.



Cells of the mucous lining of the female (fig. 14) and male (fig. 15) generative tubes of *Ascaris lumbricoides* of sheep.

a. Uterus of female, laid open, shewing the large ova-like cells on the internal surface. At a'', a few of these cells are represented, still further magnified.

b. Seminal vesicle of male, opened, in order to shew the peculiar cells by which it is lined. At b'', two or three cells, enlarged.

"These cells respectively constitute the producing or stromatous tissue in the male and female generative tubes. They demonstrate two directly opposite modes of growth in cells—one centripetal, the other centrifugal—one in which the nucleus and contents increase, the other in which, *at the expense of the nucleus and contents*, the cell-membrane acquires a considerable developement.

"They shew that from a common starting-point two series of cells, produced by tubes of apparently the same precise structure, and by one and the same nutritive fluid, may yet conceal beneath identical exteriors formative powers capable of impelling them, in the march of growth, towards two widely-separated destinations. Such *facts* convey to the physiologist, though distant, yet correct conceptions as to the nature of the 'vital force.' Certain elements of the blood pass through a simple membrane, yet in one case they emerge as the germ, in the other as the sperm-fluid! But how remarkable it is that the fluids of the lowest animal should be endowed with the same histomorphic power as those of the highest! In both cases, a plain incomplex membrane attracts a protoplasm out of the fluids which *cellulates* into the same germinal vesicles! It follows, that in one sense the fluids of the lowest animal are equal to those of the highest—that the same elements are present in both. When the physiologist has acquired a correct knowledge as to the number and variety of solid organised parts which the fluids in any given case are capable of producing, he has reached a point of information which no analyses of the fluids themselves would enable him to attain.

"A strong argument in favour of this conclusion may be drawn from the character of the solids in the trematode,* cystic, and cestoid† entozoa.

[We may here ask, has the life of the organism

* *Trema*, a pore. The order of Entozoa characterised by suctorial pores.
† *Kestos*, a girdle.

no power, or is it not concerned in the developement of the products, as well as the position and form of the products; it is the LIVING BODY that acts.]

"The *nematoid entozoa, as already stated, are destitute of every trace of a vascular system. An apparatus of vessels in these worms is, notwithstanding, described by all authors. Far too trusting confidence has been given to the delineations of Emile Blanchard. They were taken from artificial injections. They have deceived both the operator and his admirers. The proof of the absence of a vaso-fluid system rests upon two methods of examination: in the larger specimens, by dissection and by the microscope—in the smaller, by directly viewing the body as a transparent object.

"In this family of worms there exists only *one system* of fluids—which, for brevity sake, may be called the *cavitary system*, in contradistinction to the vaso or vascular system, so often present in the annelids. It is contained in part in the free chamber of the peri-visceral space, which, in the nematoids, as formerly explained, is in all species narrowed, in some almost obliterated, by the encroachment of the vesicular tissue, in part in the vesicular tissue. There is one very marked peculiarity about the cavitary fluid of this class of worms—namely, *that it is altogether destitute of every form*

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* Νημα, a thread; Εἶδος, like; Εντος, within; Ζῶον, an animal.

of floating corpuscle. This is the only example of such a peculiarity that the author is acquainted with in the whole history of the *cavitary*-fluid system of the invertebrata. It is the rule as regards the vaso-fluid system of the annelids. So little is known of the nutritive liquids of the trematode and cestoid entozoa, that at present it cannot be affirmed with certainty whether they are corpusculated or not. The cavitary fluid of the nematodes consists of a smooth, oily, homogeneous liquid, having a slightly yellow tinge, and entirely amorphous under the microscope.

"It is probably of high specific gravity, as it is of great apparent density. It strongly resembles the *serum* of the blood of a vertebrated animal. It looks very much more as if it were sucked directly into the body of the parasite, than as the product of the digestive agency of an animal so low in the scale. Sufficient quantity in the larger ascarides and strongyli may be readily collected to test its chemical properties. It is a *thick solution of albumen.* If placed in a clean watch-glass, *no coagula* of any description are formed under any circumstances. It leaves a dense smooth skin of solidified albumen on the glass, after complete evaporation. Acids throw down a thick body of albumen. From these facts the inference may be drawn that this fluid *does not contain fibrin* or any analogous self-coagulating principle. Why should the cavitary fluid of the nematodes possess these remarkable characters? Why should it be so much more rich in albumen than its homologue in the annelids, the latter animals being so much higher than the former in the scale? The chylaqueous fluid of the annelid is a watery corpusculated fluid; the cavitary liquid of the nematodes is as dense as the serum of a vertebrate animal. Is it not beyond doubt that, in both cases respectively, the fluid owes its properties to those of the medium from which it is drawn? The annelid lives in water, the nematode in blood! But the fluids of the nematode worms are *motionless*, *stagnant in the body!* In the annelids they are in constant movement. This is a peculiarity still more striking than the former. The fluids are sluggish, like the parasites themselves. The chemist will at once see that *motion* is an important accessory to all chemical operations. If the densely albuminous cavitary fluid of the nematodes were the product of blood-making processes, having their seat exclusively in the body of the worm, is it not wonderful and contrary to all analogy that these processes should not be accompanied by the mechanical circumstances of *motion?* Why there is no motion of the fluids, it is easy at once to understand. The intestine is so completely tied to the integument, that it can neither roll laterally, nor lengthen and shorten in a longitudinal direction; but the epidermis is so leathery and inflexible, that no liberty of motion is possible in any of the enclosed parts. The integuments of the nematode do not exhibit that undulatory movement which, in the sipuncles, drives the cavitary fluid incessantly and with great force from one end of the body to the other. The absence of fibrin from the nutritional fluid of these entozoa, associates itself (causally?) irresistibly with the low developement and sluggish character of their muscle-system. The absence of the mechanical circumstances of motion may, too, explain the absence of corpusculation. The vesicular tissue, and its undoubted absorptive power, cannot be separated from the fact, that the fluid by which that tissue is filled resembles most closely the serum of the animal upon which the worm is parasitic." Again, there is differentiation. Some materialists and their school, while pleading for a relationship—nay, more, an actual identity—of vital and physical force, are nevertheless obliged to admit "mind" as distinct; whilst others, going a step further, would reduce all to "conditions of matter." Now both Mr. Hunter and Dr. Laycock, deducing their conclusions from observation of the phenomena of living beings, assert the existence of the principle of life and its differentiation coincident with the *differentiation of the material organism* with which it is associated. We here require no *Deus ex machinâ*, for the germ contains within itself all the laws of its existence, which also includes the preservation of its species. Dr. Harris has perhaps put this in a much clearer point of view than any one who has handled the subject, and certainly coincides with both the authors whom we have last cited:

Now profound as the subject of life is, all its operations will be found to be impressed with the regularity of general laws. On this condition alone can we hope to ascertain its operations and mark the wisdom which they evince. The vital principle, once superinduced by the living God, acts *according to his appointment* and under his superintendence, with constancy and certainty. True it is, that in studying organic life, we find ourselves for the first time in the regions of mutual adaptations; and that the writer on Systematic Botany is obliged to indite a chapter of anomalies. Unlike the law of chemical affinity, which requires that the compound be in definite proportions, we find that life asserts its freedom and its power by dispensing with this chemical exactness. But even this freedom is only within certain limits, or is bounded by law. This power of adaptation is according to particular rules, which are all ranged under a general rule. It is a law unto itself. For example: oxygen is indispensable to the germination of seeds; where it is entirely wanting, as in distilled water, they will not germinate; while, if acted on by more than a certain proportion, they will be over-stimulated. But let them have *about* the right proportion—one part of oxygen, with three of azote—and they will germinate accordingly. The general law cannot be violated; while the power of adaptation, by which the seed is adjusted to the circumstances, is itself regulated by the universal law which measures the cause by the effect, and which determines that its action shall be always the same in the same circumstances. And as no compliance with the other conditions of germination will compensate for the want of the necessary oxygen, so no supply of this alone will atone for the absence of the other conditions of germination. Its constitution is defined by laws, which must be complied with.

These laws, indeed, must not be confounded with causes. The life of the plant pre-supposes the organisation which the Creator has been pleased to make a necessary condition: this condition, however, *is not the cause* of its vitality, but only the *means* of its manifestation. And organisation presupposes certain inorganic conditions; but these conditions are not the cause of it; they are only employed and subordinated to organic ends. All that we recognise, in either case, is the law or rule according to which the organic and inorganic are made to act; the cause of that action is entirely distinct.

The organs by which life acts may be anatomically examined, and correctly classed; but life is something independent of them all: for not one of them is universal in organised nature, and therefore is not essential to the vital force. The functions of these organs may be known, and the chemistry of their operations be silently and perseveringly watched; but the principle of that chemistry, the cause of these functions, are meanwhile pre-supposed and unapproached. The proximate organic principles, which the chemistry of life produces, and submits to our examination, may be minutely analysed and correctly named; but they have been produced in circumstances which we cannot imitate, and, in fact, do not understand. They are, at best, only proximate principles; effects which refer us to the existence of a cause, the nature of which they do not reveal; their very number and diversity not explaining, but multiplying the mysteries in which it is involved. The little "nucleated cells," evolved from these proximate principles, and by the developement of which the organic mass is supposed to be enlarged, may be known and truly described; but this is something already existing, *the cause which has* led to it is still pre-supposed.

If the law, to which reference has been already made, be true, viz., "the progression from the general to the special," as anatomists declare it to be, and which is well exemplified in the vertebrate kingdom, we have exactly the same grounds for maintaining the differentiation of life and its specialisation throughout the whole organised world; and this applies not only to the functional life of the organism, but even to the term of its existence. "It may," says Mr. Paget, "be proved, partly by demonstration, and partly by analogy, that each integral or elemental part of the body is formed for a certain natural period of existence, in the ordinary condition of active life, at the end of which period, if not destroyed by outward force or exercise, it degenerates and is absorbed, or dies and is cast needing in either case to be replaced for the maintenance of health. The simplest examples that can be adduced are in the growth of the hair and teeth: an eye-lash, which naturally falls, or which can be drawn out without pain, is one that has lived its natural time and has died, and been separated from living parts. In its bulb, such an one will be found very different from those that are still living, in any period of their age. In the early period of the growth of a dark eye-lash, we find its outer end almost uniformly dark, marked only with darker short linear streaks, and exhibiting no distinction of cortical and medullary substance. Not far from its end, however, this distinction is plainly marked; dark as the cortical part may be, the medullary appears like an interior cylinder, of much darker granular substance; and in a young hair this condition is continued down to its deepest part, where it enlarges to form the bulb. Now this enlargement, which is of nearly cup-like form, appears to depend on the accumulation of round and plump nucleated cells, which, according to their position, are either, by narrowing or elongation, to form the dry fibro-cells of the outer part of the growing and further protruding shaft, or are to be transformed into the air-holding cells of the medullary portion. At the time of most active growth, both cells and nuclei contain abundant pigment matter, and the whole bulb looks nearly black. The sources of the material out of which the cells form themselves, are at least two, viz., the inner surface of the sheath or capsule, which dips into the skin, enveloping the hair, and the surface of the vascular pulp, which fits in a conical cavity in the bottom of the hair bulb.

Such is the state of parts so long as the growing hair is at all dark. But as it approaches the end of its existence, it seems to give tokens of advancing age, by becoming gray. Instead of the almost sudden enlargement at its bulb, the hair only swells a little and then tapers nearly to a point; the conical cavity in its base is contracted and hardly demonstrable, and the cells produced on the inner surface of the capsule contain no particle of pigment. Still for some time it continues thus to live and grow, and we find that the vigour of the conical bulb lasts rather longer than that of the sheath or capsule; for it continues to produce pigment matter some time after the cortical substance of the hair has been entirely white, and it is still distinct because of the pigment cells covering its surface.

At length the pulp can be no longer discerned, and unclosed cells above are produced, and maintain the latest growth of the hair. With these it appears to grow yet some further distance; for we see traces of their elongation into fibres or fibro-cells, in lines running from the inner surface of the capsule inwards and along the surface of the hair; and we can always observe that the dark colour of medullary air-containing substance ceases at some distance above the lower end of the contracted hair-bulb. The end of all is the complete closure of the conical cavity in which the hair-pulp was lodged; the cessation of the production of new cells, and the consequent detachment of the hair as a dead part, which now falls by the first accident: falls sometimes quite bear and smooth on the whole surface of its white bulb, but sometimes bringing with it a layer of cells detached from the inner surface of the capsule. Such is the life of a hair, and such its death.

Facts seem to shew that the ordinary course of such elementary organ in the body, after the attainment of its perfect state by developement and growth, *is to remain* in that state for a time; then independently of the death or decay of the *whole body*, and at least in a great measure, independently of its own exercise or exposure to external violence, to die, or to degenerate; and then being cast out or absorbed, to make way for its successor. It appears, moreover, very probable that the *length of life* which each part is to enjoy is fixed and determined, though of course in some degree subject to accidents, which may shorten it, as sickness may prevent, or through mere old age; and subject to the expenditure of life in the exercise of function."

Professor Carpenter, to whom we are indebted for the full recognition of this law of specialization of life, thus enunciates his opinions: "We distinguish the following as the principal manifestations of cell-life:

"*a. Growth* of the original cell, from its germ to maturity; involving the *selection* and *appropriation* of its materials.

"*b. Multiplication*, by the sub-division either of the original cell or of its nucleus.

"*c. Chemical transformation*, exerted upon the *pabulum* of the cell, whereby new products may be generated in its interior.

"*d. Vitalization* of a portion of the pabulum, whereby it becomes endowed with vital properties *of its own*, so as even to originate cells *de novo*.

"*e. Permanent changes of form*, taking place in connexion with acts of growth, and giving a peculiar character to the tissue.

"*f. Temporary changes of form*, applied to the generation of mechanical force, and to the production of sensible motions.

"*g. Production of nerve force*, which may affect all the preceding operations, and which is ultimately related to mental agency.

"That these various phenomena are to be regarded as manifestations of one and the same vital force, of which the several modifications of organic structure that exhibit them are the respective instruments, may be argued, not merely from the facts already urged, but also from the community of origin of all the tissues and organs of each individual, *in a single primordial cell.* For like the humblest forms of vegetable and animal life which permanently consist of separate and independent cells, the embryo of even the highest types of each kingdom, in the earliest phase of its developement, is but a single cell; and during the earlier periods of its increase, we observe that it displays only that *most general* manifestation of cell-force which consists in growth and multiplication.

"The descendants of this parent-cell, however, soon begin to undergo a variety of transformations, and to assume a diversity of character; and we observe, in fact, that a sort "of division of labour" takes place among them, each group of cells being appropriated *to some particular office*, and discharging *it alone to the exclusion of the rest;* as if by this special direction of the vital force, the cell which is its instrument is unfitted for any other kind of vital agency. Of this relation of reciprocity between the several manifestations of vital power, the following examples among others may be cited:—When the whole energy of the cell is directed to *multiplication*, we do not observe either chemical transformation or change of form, or developement into any other tissue; nor do we find that either motor power or nerve force is generated. Of this we have already had an example in that early phase of embryonic life, in which cell-multiplication takes place with extraordinary rapidity. In the formation of new parts, which make their appearance at a subsequent time, we find that their foundation is laid in a mass of cells, which rapidly multiply, up to a certain point, (like those of the embryonic mass,) without any change of form or character; and that when they have once begun to undergo developement into other kinds of tissue, they multiply no longer. So, again, in those cancerous growths, whose rapid increase is one of their most distinctive features, we usually observe that the whole texture retains its primitive cellular character; and that the developement of higher forms of tissue only occurs in those whose growth is slower, these cells having ceased to multiply themselves thus rapidly, when they underwent histological change. But, perhaps, one of the most striking examples of this principle is presented by those glandular follicles, which act as parent cells, developing in their interior a successional progeny, which are the true *secreting* cells: for the former possess no secreting power, *their vital force* *being expended* in the production of the latter; whilst, on the other hand, the latter possess no reproductive power, but die and are cast off when they reach their maturity, even their own cell walls being usually very imperfectly developed, as if their whole vital force had been expended in the secreting process. So, again, the cells whose vital force is exerted in mechanical movement, seem exclusively adapted for this purpose, apparently performing no other vital changes than those developed in their own developement. Thus the ciliated epithelium cells which line the respiratory passages, and the ducts of many glands, appear never to perform that secretory function, which is discharged by other non-ciliated cells of the same stratum; so that their mode of production and the general conditions of their developement being essentially the same, we can scarcely fail to regard the ciliary movement and the secreting action as, however dissimilar in themselves, two modes of operation of one and the same cell-force, [life-force]. Again, the elongated cells, which constitute the non-striated muscular fibre, and the minute cellules of which the fibrillæ of the striated muscular fibre are made up, seem to exercise no chemical change, to undergo no further developement, and to undergo disintegration without having multiplied themselves: so that all increase and regeneration of muscular tissue appear to take place, either by production de novo, or, possibly—in the case of striated fibre—by the continued developement of new cells from the nucleus of the parent cell, which, like that of the glandular follicle, performs *no other function* than that of multiplication. The cells composing nerve tissue, again, do not shew any indication of reproductive power, and seem to undergo disintegration, as the direct consequence of the production of nerve-force; so that they, too, appear to expend their whole vital energy in one particular mode of action, and to have no power to spare for any other."

In the sixth chapter of the same work, Prof. Carpenter, continuing the subject, observes: "By the study of the various forms of elementary tissue, of which the human fabric is made up, we are led to the very same conclusion with that which we draw from the observation of the simplest forms of organised beings, or from the scrutiny into the earliest condition of the most complex, viz., that *the simple cell may be regarded as the type of organisation; and that on its actions rests our fundamental idea of life.* Between the humblest plant and the embryonic human organism, there is, originally, no perceptible difference; they may be said to have a common starting-point; and the subsequent difference in their course consists essentially in this, that the successive generations of cells, which are the descendants of the former, *are all similar to it and to each other*, each cell being capable of maintaining an *independent* existence ; whilst the subsequent generations, which originate from the latter, progressively become more and more *dissimilar* to each other, and more and more mutually dependent ; so that whenever it is thrown entirely upon *its own* resources, the integrity of the whole fabric becomes essential to the continued life of any individual cell. Every individual part, however, even in the most complex and highly organised fabric, has its own capacity of developement, and *the properties* which it *possesses* are the result of its exercise.

Mr. Huxley, in his resume of cell-growth, observes :—

"It is less generally (we might say hardly at all) known that Caspar Wolff demonstrated, by numerous observations on developement, the doctrine of the metamorphosis of plants, when Goethe, to whom it is commonly ascribed, was not quite ten years old; but it seems to have been wholly forgotten that he endeavoured to work out, upon the basis of the strict study of histological and morphological developement, that 'identity of structure of plants and animals' which is the thesis defended by Schwann. Had Wolff's teaching been founded upon one of those clever guesses upon which an able man will often build up a plausible hypothesis, we should have thought it quite unnecessary to make even historical reference to him ; but the most cursory examination of the 'Theoria Generationis,' or of the more popular and discursive exposition of his views in the 'Theorie von d. Generation,' is enough to dispel any such notion. The passage we have already quoted is sufficient to shew how just and accurate Wolff's ideas upon the importance of the study of developement, as a method, were; and the whole of his work is the laborious application of that method. The parts of the calyx, of the corolla, and of the pericarp, are for him 'modified leaves;' not because certain observed modifications had suggested that they might be so considered—which is the whole gist of Goethe's subsequent argument—but because he had carefully traced back their developement, and had found that they all proceeded from the same original form. The homology of the wing of the chick with its leg, is placed by Wolff on precisely the same basis—the only one, be it observed, on which any homology can ultimately rest; and following out the argument to its legitimate conclusion, he shews that the appendicular organs of plants and animals are developed after the same fashion. The limbs of animals, he says, are developed in the same manner from the body of the embryo, as the leaf from the stem, or the lamina of the leaf from its mid-rib. Ordinary four-footed animals are like pinnatifid leaves, while 'the bat is a perfect leaf—a startling statement, but, as I have shewn, the analogy is not chimerical, for the *mode of origin of the two is the same.*'

"Wolff's doctrine concerning histological developement is shortly this. Every organ, he says, is composed at first of a little mass of clear, viscous, nutritive fluid, which possesses no organisation of any kind, but is at most composed of globules. In this semi-fluid mass, cavities (*Bläschen*, *Zellen*) are now developed ; these, if they remain rounded or polygonal, become the subsequent cells—if they elongate, the vessels ; and the process is identically the same, whether it is examined in the vegetating point of a plant, or in the young budding organs of an animal. Both cells and vessels may subsequently be thickened, by deposits from the 'solidescible' nutritive fluid. In the plant, the cells at first communicate, but subsequently become separated from one another ; in the animal, they always remain in communication. In each case, they are mere cavities, and not independent entities ; organisation is not effected by them, but they are the visible results of the action of the organising power inherent in the living mass, or what Wolff calls the *vis essentialis*. For him, however, this 'vis essentialis' is no mythical *archæus*, but simply a convenient name for two facts which he takes a great deal of trouble to demonstrate ; the first, the existence in living tissues (before any passages are developed in them) of currents of the nutritious fluid determined to particular parts by some power which is independent of all external influence ; and the second, the peculiar changes of form and composition, which take place in the same manner.

"Now there is really no very great difference between these views of the mode of developement of the tissues, and those of Schleiden and Schwann. The 'solidescible nutritive fluid' of Wolff is the 'cytoblastema' of Schleiden and Schwann; with the exception of the supposed relation of the nucleus to the developement of the cell (which, as we shall see, is incorrect) Wolff's description of the latter process is nearly that of Schleiden; Wolff maintains that the 'vessels' of plants are the result of the greater activity of the nutritive currents in particular directions; and so does Schleiden.

"Examining his statements closely, we notice, indeed, that his imperfect means of investigation led Wolff into two important errors—that of supposing the cells of plants to communicate in their youngest state, and thence deducing a false analogy with the areolar tissue of animals; and that of supposing that animal and vegetable tissues are always, in their very youngest state, absolutely structureless. However, as we shall see subsequently, Wolff is by no means singular in having started with grave anatomical mistakes, and we cannot perceive that in his case these errors, one of which, at any rate, Schleiden shares with him, vitiate those other and more important parts of his views, to which we are about to refer.

"We have said, in fact, that not merely speculatively, but by observation, Wolff established a theory of the devolopement of the vegetable tissues very similar to that of Schleiden, and that 'identity of structure as shown by their developement,' between plants and animals, to prove which was the purpose of the microscopical investigation of Schwann. But he did much more than this. In the 'Theoria Generationis,' and in the essay on the vital forces published thirty years afterwards, Wolff developed some very remarkable views on the relation of life to organisation—of the vital processes of the organic elements—in which he diverges very widely from all who preceded, and from most who have followed him, most of all from Schleiden and Schwann. We may best exhibit the bearing of these views by contrasting them with those of the latter writers.

"Schleiden and Schwann teach implicitly that the primary histological elements (cells) are independent, anatomically and physiologically; that they stand in the relation of *causes* or *centres*, to organisation and the 'organising force;' and that the whole organism is the result of the union and combined action of these primarily separate elements. Wolff, on the other hand, asserts that the primary histological elements (cells too, but not always defined in the same way) are not either anatomically or physiologically independent; that they stand in the relation of *effects* to the organising or vital force (vis essentialis); and that the organism results from the 'differentiation' of a primarily homogeneous whole into these parts. Such a doctrine is, in fact, a most obvious and almost a necessary developement of the doctrine of epigenesis in general. To one who had worked out the conclusion, that the most complex, grosser, animal or vegetable organisations, arise from a semi-fluid and homogeneous mass, by the continual and successive establishment of differences in it, it would be only natural to suppose that the method of nature, in that finer organisation which we call histological, was the same; and that as the organ is developed by the differentiation of cells, so the cells are the result of the differentiation of inorganic matter. If the organism be not constituted by the coalescence of its organs and tissues in consequence of their peculiar forces, but if, on the other hand, the organism exists before its organs and tissues, and envolves them from itself,—is it not probable that the organs and tissues also, are not produced by the coalescence of the cells of which they are composed, in consequence of *their* peculiar forces, but, contrariwise, that the cells are a product of the differentiation of something which existed before them?

"For Schwann the organism is a beehive, its actions and forces resulting from the separate but harmonious action of all parts (compare Schwann, l. c., p. 229). For Wolff it is a mosaic, every portion of which expresses only the conditions under which the formative power acted and the tendencies by which it was guided.

"We have said above, not without a full consciousness of the responsibility of the assertion, that we believe the cell-theory of Schleiden and Schwann to be based upon erroneous conceptions of structure, and to lead to errors in physiology, and we beg now to offer some evidence in favour of these views. We need not stop to prove, what must be familiar to every one who is acquainted with Schwann's work, that in making his comparison of animal with vegetable structures, he rests wholy upon Schleiden's statements concerning the developement, and upon the commonly prevalent views with respect to the anatomy, of the latter.

"It is clear, then, that however logically consequent Schwann's work may be in itself, its truth and the justice of its nomenclature will depend upon that of these latter views and statements. Schwann took these for granted, and if they were untrue he has been trusting to a rotten reed. Such, we fear, has indeed been the case. Schwann's botanical data were :

1. "The prevalent notion of the anatomical independence of the vegetable cell, considered as a separate entity.
2. "The prevalent conception of the structure of the vegetable cell.
3. "The doctrine of the mode of its developement

"Each of these, assumed by Schwann, and as taught by Schleiden, has since, we shall endeavour to show, been proved to be erroneous. We will take them *seriatim*.

1. "The first observer who, aided by the microscope, turned his attention to the structure of plants, was the versatile Hooke, and, as might be expected, the most noticeable thing to his mind was the existence of the innumerable cavities or 'cells' scattered through their substance. Malpighi, the first proper botanical histologist, found that the walls of these vesicles were separable, that they could be isolated from one another, and therefore, doubtless urged more by the obvious convenience of the phraseology, than by any philosophical consideration upon the subject, he gave each the definite name of 'utriculus,' and regarded it as an independent entity. Of course it was a natural consequence that the plant should be regarded as constituted by the *union and coalescence* of a great number of these entities.

"Grew, who, if all scandal be true, is so much indebted to Malpighi, did not appropriate this view among other things; on the other hand, he compared the utricles to the cavities in the foam of beer; and subsequently Wolff propounded the idea, that the cells were cavities in a homogeneous substance, as we have mentioned above. In modern times, the most important defender of this mode of regarding the matter has been Mirbel, who (escaping the error of Wolff, that the cavities of the cells communicate) endeavoured to demonstrate its truth, by tracing the formation of the cambium; but, at the time when Schwann wrote, it must be considered to have been wholly discredited, the opposite view having one of its strongest supporters in the caustic Schleiden himself—as, indeed, would necessarily be the case, from the tendency of his researches upon phytogenesis. As we shall see below, however, Schleiden was quite wrong in his ideas of cell-development—and we have therefore merely to consider the purely anatomical arguments for the independence of the cell. Now these amount, however various their disguise, to nothing more than this—that, by certain chemical or mechanical means, a plant may be broken up into vesicles corresponding with the cavities which previously existed in it: of course no one denies this fact; but of what value is it? Is the fact, that a rhombohedron of calcareous spar breaks up, if pounded, into minute rhombohedrons, any evidence that those minuter ones were once independent, and formed the larger by their coalescence? Is the circumstance that wood itself tears up into fibres, any evidence that it was formed by the coalescence of fibres? Assuredly not; for every hand-book will tell us that these fibres are the result of a metamorphosis of quite different parts. Is it not perfectly clear, that the behaviour of a body under mechanical or chemical influences, is simply an evidence of the disposition of the lines of great cohesion or affinity among its particles *at the time being*, and bears not in the slightest degree upon the question as to what these lines indicate ; whether they are the remains of an ancient separation among heterogeneous parts, or the expression of a recent separation which has arisen in a homogeneous whole. So that, if the walls of the cells were really as distinct from one another as is commonly supposed, it would be no argument for their vital independence : but they are not so. Von Mohl has shewn that, in the great majority of cases, the assumption of the existence of a so-called inter-cellular substance, depends simply on imperfect chemical investigation—that there exists no real line of demarcation between one cell and another, and that wherever cells have been separated, whether mechanically or chemically, there is evidence that the continuous cellulose substance has been torn or in some way destroyed. In young tissues—such, for instance, as the cambium, or the base of a leaf, we have been quite unable to detect the least evidence of the existence of any line of demarcation between the cells ; the cellulose substance forms a partition between cavity and cavity, which becomes evenly blue throughout by the action of sulphuric acid and iodine, and which certainly, even under the highest powers, exhibits no symptom of any optical difference ; so that, in this state, vegetable tissue answers pretty closely to Wolff's idea. It is in a homogeneous cellulose-yielding, transparent substance, containing cavities, in which lie peculiar vesicular bodies, into whose composition much nitrogen enters. It will be found a great aid if in the present confused state of terminology the reader will accept two new denominations for these elementary parts, which express noting but their mutual relation. To the former, and to every thing which answers to it, we shall throughout the present article give the name of *Periplast*,* or periplastic substance; to the latter, that of *Endoplast*.** So far, then, from the utricles or cells in the plant being anatomically distinct, we regard it as quite certain, that that portion which corresponds with the periplast, forms a continuous whole through the entire plant.

2. "In 1837–8, each utricle of the plant was considered to have the following composition. In the first place, there was the cellulose cell-wall, or the portion of periplast answering to any particular endoplast; secondly, there were the cell-contents, a substance of not very defined nature, which occupied the cavity of the cell, and thirdly, there was the *nucleus*, a body to whose occurrence attention was first drawn, as is well known, by our own illustrious botanist, Robert Brown. He, however, cautiously remarked only its very general occurrence, without pretending to draw any inference from the fact; while Schleiden made the belief in its existence in

* Περν, a circle round; Πλασμα, that which has been formed.
** Ενδον, within : πλασμα.

all young tissues, the first article of the faith botanical. This is, however, most certainly incorrect; there is no trace of a nucleus in many Algæ, such as a Hydrodictyon, Vaucheria, Caulerpa; in the leaf of Sphagnum, nor in young germinating Ferns.

"Whatever opinion may be entertained upon this head, there is one point quite certain—the enumeration of the elements of the vegetable-cell given above is incomplete; there being one, and that the most important, which is omitted. We refer to the *primordial utricle*, which was only discovered by Von Mohl in 1844. This is a nitrogenous membrane, which always lies in close contact with the periplast, and forms, in fact, an included vesicle, within which the 'contents' and the nucleus lie. Instead, therefore, of the endoplast consisting merely of contents and a nucleus, it is a vesicle containing the two latter, when they exist at all; and they are of subordinate importance, for while, as we have seen, a nucleus and formed contents may be absent in young or even fully formed tissues, the primordial utricle is invariably present in the young structures, and often persists until they have attained their full size. Since, then, the functions of the vegetable 'cell' can be effectually carried on by the primordial utricle alone; since the 'nucleus' has precisely the same chemical composition as the primordial utricle; and since, in some cases of cell-division, new nuclei are seen to arise in the substance of the endoplast, by a mere process of chemical and morphological differentiation (Von Mohl. l. c., p. 52), it follows, we think, that the primordial utricle must be regarded as the essential part of the endoplast—the protoplasmand nucleus being simply its subordinate, and, we had almost said, *accidental* anatomical modifications.

3. " Finally, with respect to Schleiden's observations upon the mode of cell-developement, according to which in all cases the new production of vegetable-cells takes place by the developement of nuclei, round which the cell-membrane is deposited, subsequently expanding and becoming separated from the nucleus, so as to form a complete cell; we need only say, that they have been long since set aside by the common consent of all observers; in Von Mohl's words (p. 59): 'The whole of this account of the relation of the nucleus to the cell membrane is incorrect.' The fact is, that in by far the greater proportion of cases, new cell-developement occurs by the division of the previous endoplasts, and the growth or deposition round them and between them, of fresh periplastic substance. The extent of this process of division will be understood, if we remember that all observers now agree in its being the method by which 'cell-developement' always occurs, except in the embryo-sac of the Phanerogamia, the sporangia of Lichens and of some Algæ and Fungi. The so-called free cell-developement of the latter,

however, by no means takes place in accordance with Schleiden's views, but by the developement of a cellulose membrane (periplast) around a mass of nitrogenous substance (endoplast), which may or may not contain a nucleus; subsequently increasing, *pari passu*, with the periplast. And it is well worthy of consideration, how far the process deserves any distinction, except in degree, from ordinary cell-division, since the new endoplast is only one portion of that of the parent cell, set aside for the purpose of fresh developement, while the rest undergoes no corresponding change. However this may be, it may be regarded as quite certain, that, leaving out of view the immediate results of sexual reproduction, the whole of the 'cells'—the entirety of the periplasts and endoplasts—of which a plant, whether it be a moss or an oak, are composed, never are independent of one another, and never have been so, at any period of their existence; but that, while the original endoplast of the embryo-cell, from which the plant sprung, has grown and divided into all the endoplasts of the adult, the original periplast has grown at a corresponding rate, and has formed one continuous and connected envelope from the first. The ground of his comparison, therefore, is cut away from under Schwann's feet; every statement of Schleiden's on which he relied turning out to be erroneous—as we shall see if we turn to his original comparison of cartilage with a vegetable tissue (pp. 9—17).

Fig. 1.

A, Collenchyma cells of Beta vulgaris; B, Stellate tissue of the pith of the rush; C, a cartilage-cell with its corpuscle, to compare with D, a vegetable-cell with its nucleus, the primordial utricle in the latter being indicated only by a dotted line.

Schwann, finding in cartilage cavities with more or less distinct walls, in each of which lay a corpuscle, singularly resembling the nucleus of the vegetable-cell; finding also that the cell-wall was close to this corpuscle in the younger parts, more distant from it in the older, naturally concluded that he had here, in the animal world, an exact confirmation of Schleiden's supposed discoveries, and of course gave to the corpuscle of cartilage the name of 'cytoblast,' or 'nucleus,' as indicating its homology with the structure of that name in the plant.

"The primordial utricle was, as we have said, not then discovered in the latter, and of course Schwann was not led to look for any thing corresponding to it. Indeed, had he done so, his search would have been unsuccessful, for the young and unaltered cartilage cavity contains the corpuscle, and nothing else. The circumstance, therefore, which Schwann considered to demonstrate the identity of structure of plants and animals—*i. e.*, the correspondence of the cartilage-corpuscle with the nucleus of the vegetable-cell, and of the chondrin-wall with the cellulose-wall, would, if it were really the case, be the widest possible ground of distinction between the two, for it would leave the most important element of the latter, the 'primordial utricle,' without any homologue in the animal, and totally unaccounted for.

"It is precisely the neglect of this important change in the whole subject, effected by the discovery of Von Mohl, which has, we think, led to the confusion which prevails at present, not only in the comparative, but in the absolute nomenclature of animal histology. Animal physiologists go on using Schwann's nomenclature, forgetting that the whole doctrine of the vegetable-cell, from which he drew that nomenclature, has been completely upset; and at present, beyond the mere fact of a common vesicularity at one period of their existence, one would be led, on opening successively two works on animal and vegetable structure, rather to predicate their total discrepancy, than any uniformity between them:

"Now does this discrepancy lie in the facts, or in our names of them? To decide this question, it seemed to us that the only plan was to follow Schwann's steps, and to compare cartilage with a vegetable tissue—for he has shewn logically and conclusively enough, that whatever is true of the corpuscle of cartilage, to which he gives the name of 'nucleus,' is true also of all those corpuscles in the other tissues, to which he gives the same name.

"Let us compare, then, some young vegetable tissue, say that of the base of a sphagnum leaf (fig. 2. A), which is in many respects very convenient for examination, with that of young cartilage (fig. 3. A); the identity of structure is such, that it would be difficult, without the aid of chemical re-agents, to distinguish one from the other: in each, we see highly nitrogenous, more or less vesicular endoplasts imbedded in a homogeneous transparent substance, whose cavities they wholly fill. If we trace the further developement, we find that in the Sphagnum leaf the endoplasts and their cavities rapidly increase in size (fig. 2. B), the former becoming, in certain localities of the leaf, regular primordial utricles without any nucleus, and growing in exact proportion to the cavities in the periplast (*b*), while in other directions, having attained a certain size they cease to grow, and rapidly disappear, leaving the periplastic cavity empty. (*a*) In cartilage, precisely the same thing occurs. The endoplasts increase in size for awhile, and then stop, while the periplastic cavities continue to increase, and thus we have eventually a cartilage-cavity with its corpuscle. In old cartilage the latter frequently disappears, or is converted into fat. We have here purposely selected, in both the animal and the plant, simple cases, in which the endoplast becomes a primordial utricle.

without any nucleus. Had we selected the cambium of a phœnogamous plant, it would have been merely necessary to add, that as the endoplast grew, a nucleus appeared in its interior; and in ossifying cartilage, near the ossifying surface, we have repeatedly seen endoplasts such as those described above, some of which contained definite 'nuclei,' while those in their immediate neighbourhood possessed none.

"In the case of cartilage, then, (and it is a conclusion at which Leidy and Remak have already arrived,) we hold it to be proved, that the corpuscle does not correspond with the nucleus of the plant, as Schwann supposed, but with the primordial utricle, contents and nucleus; or, in other words, that the 'nucleus' of cartilage, is the equivalent of the 'primordial utricle' of the plant—that they are both endoplasts. It follows, hence, that the chondrin-wall of the cartilage, is the homologue of the cellulose wall of the pl[illegible] that they both represent the periplastic ele[illegible] phenomena of growth and multiplicatio[illegible] by these corresponding elements are perfectly similar. The process of cell-division, as it is called, is identical in each case. In the plant, the primordial utricles divide, separate, and the cellulose substance grows in between the two. In young cartilage the same thing occurs, the corpuscles divide, separate, and the chondrin substance eventually forms a wall of separation between the two. There is neither endogenous development nor new formation in either case. The endoplasts grow and divide, the periplast grows so as to surround the endoplasts completely, and, except so far as its tendency is, to fill up the space left by their separation, there is no evidence that its growth is in any way affected by them, still less, that it is, as is often assumed, deposited by them. We are led, then, to the conclusion, that though Schwann's great principle of the identity of structure of plants and animals is perfectly correct, his exposition of it is incorrect, inasmuch as the corpuscle of cartilage (his 'nucleus,' whence he reasoned to the other 'nuclei') answers not to the 'nucleus,' but to the 'primordial utricle' of the plant; since the mode of developement of new 'cells,' though identical in each case, is different from what Schleiden stated, and Schwann believed; and finally since, for the notion of the anatomical independence of the cells, we must substitute that of the unity and continuity of the periplastic substance in each case.

"Intimately connected with these structural errors, as we cannot but think them, are Schwann's views of the nature and powers of the 'cell,' and those subsequently developed (principally by Kolliker) with respect to the action of the nuclei as 'centres of force.' Led apparently by his views of its anatomical independence, Schwann maintains, as a general proposition, that the cell as such possesses powers which are not inherent in its separate molecules.

"'We must, in fact, ascribe an independent life to cells—i.e., the combination of molecules which take place in a single cell are sufficient to set free the force, in consequence of which the cell has the power of attracting new molecules. The cause of nutrition and growth lies not in the organism as a whole, but in the separate elementary parts—the cells. That in point of fact every cell when separated from the organism, is not capable of further growth, as little militates against this theory, as its incapability of existing separate from the swarm would be an argument against the independent life of a bee. The enquiry into the fundamental forces of organisms, therefore, is reduced into one concerning the fundamental forces of the single cells.' (p. 229.)

"And yet, strongly as Schwann maintains, not only here but in many other places, the view that the vital forces are manifested by the cells as machines, and are not inherent in the matter of which these cells are composed, apart from their form; he gives it up in effect when he comes to treat of these forces in detail. The fundamental cell-forces are, he says, of two kinds, the attractive and the metabolic, the former regulating growth, the latter determining the chemical changes; and he shows very justly that these forces are not located in any special centres in the cell, but are exhibited by all its solid constituents (pp. 233, 236), and that they may be exhibited by different portions of these solid constituents, and to a different extent by these different portions (p. 233); proving hereby, very clearly, as it seems to us, that the forces in question are not centralised in the cells, but are resident in their component molecules. All Schwann's able comparison of cell-developement with crystallisation, tends in fact to the same conclusion. When matter crystallises from a solution, the presence of a foreign body may determine the place and form of the deposit; but the crystals themselves are the result, not of the attractive forces of the foreign body, but of the forces resident in their component molecules. So in cell-developement, if it is to be rigorously compared to crystallisation, even if the nuclei represent the foreign bodies, which determine the place of the chemical and morphological alterations in the surrounding substance, it by no means follows that they are their cause.

"Kolliker (§§ 11, 13), resting especially upon the phenomena of yelk-division and of endogenous cell-developement, advocates the existence of a peculiar molecular attraction proceeding from the nucleolus first, and subsequently from the nucleus. Now as regards endogenous cell-developement, we must confess that we can find no more ground for its occurrence among animals than among plants. Nageli's cell-developement around portions of contents, upon which Kolliker lays so much stress, is nothing more than a case of division of the endoplast (primordial utricle) and subsequent developement of pleriplastic substance round the portions. In cartilage, which is so often quoted as offering marked endogenous cell-developement, we must agree with Leidy and Remak, that nothing but division of the endoplasts (nuclei, primordial utricles) and in-growth of the periplast (intercellular substance, cell-wall) occurs. In these endoplasts again, the very existence of a nucleus is in the highest degree variable and inconstant, and division occurs as well without it as with it.

"The process of yelk-division—that remarkable manifestation of a tendency to break up, in the yelk of most animals, into successively smaller spheroids, in each of which a nucleus of some kind appears—seems, at first, to offer very strong evidence in favour of the exertion of some attraction by these nuclei upon the vitelline mass. But we think that a closer examination completely deprives this evidence of all weight. In the first place, the appearance of the nuclei is in many cases subsequent to segmentation. It is thus in Strongylus auricularis (Reichert), in Phallusia (Krohn), in the hen's egg (Remak). In the second place, it seems difficult to conceive any mode of operation of a central attractive force which shall give rise to the phenomena of segmentation, for the resulting spheroids always pass into one another by extensive plane surfaces, whereas the even action of two attractive centres, in a mass free to move, would give rise to two spheroids in contact only by a point. Again, Remak has observed, that in the frog's egg the time occupied by the formation of the groove, indicating the first line of cleavage upon the upper half of the yelk, is very much shorter than that required to give rise to the corresponding line upon the lower half—a fact which is quite unintelligible upon the theory of a central attraction.

"Thirdly, in Cucullanus, Ascaris dentata, &c., Kolliker has shewn, that though nuclei are developed, no yelk-divisions occur; and in the latter stages of division of the frog's egg, yelk masses are found undivided, and containing many nuclei.

"Finally, in Ascaris mystax, according to Dr. Nelson, the embryonic visicles absolutely revolve in circles during the progress of yelk-division—a phenomenon which seems incompatible with the existence of any mutual attractive reaction between themselves and the vitelline mass.

"We see, in short, that the effects of the force supposed to be exerted by the nuclei may take place without them, and, on the other hand, that the nuclei may be present without exerting the peculiar forces which they are supposed to possess; and finally, that even if such forces exist, they must be something very different from all the attractive forces of which we have any conception; and that the hypothesis of nuclear force is no explanation, but merely a fresh name for the difficulty.

"We are as little able to discover any evidence of the existence of metabolic forces in the nuclei. The metabolic changes of the tissues—such as we see, for instance, in the conversion of cartilage into bone, of cartilage into connective tissue—do not take place, either primarly or with greater intensity, in the neghbourhood of the nuclei; a fact of which striking evidence is afforded by ossifying cartilage, in which the first deposit of calcareous matter occurs, not in areæ surrounding each nucleus, as we should expect if they exerted a metabolic influence, but in straight lines, which stretch from the ossified surface into the substance of the matrix of the cartilage, and the amount of calcareous matter in which gradually diminishes as we recede from the ossified part, without the least reference to the nuclei. It is the same with the metamorphosis of the periplast of the cartilage when it passes into tendon.

"From all this we consider it to be satisfactorily shewn, that there is no evidence that the 'cells' of living bodies are, in any respect, *centres* of those properties which are called *vital forces.* What, then, are these cells? it may be asked. What is the meaning of the unquestionable fact, that the first indication of vitality, in the higher organisms at any rate, is the assumption of the cellular structure?

"In answering these questions, we would first draw attention to the definition of the nature of developement in general, first clearly enunciated by

Von Baer. 'The history of developement,' he says, 'is the history of a gradually increasing differentiation of that which was at first homogeneous.' The yelk is homogeneous; the blastoderma is a portion of it which becomes different from the rest, as the result of the operation of the laws of growth; the blastoderma, again, comparatively homogeneous, becomes differentiated into two or more layers; the layers, originally identical throughout, set up different actions in their various parts, and are differentiated into dorsal and visceral plates, chorda dorsalis and bodies of vertebræ, &c., &c. No one, however, imagines that there is any causal connexion between these successive morphological states. No one has dreamt of explaining the developement of the dorsal and visceral plates by blastodermic force, nor that of the vertebræ by chorda-dorsalic force. On the other hand, all these states are considered, and justly, to result from the operation of some common determining power, apart from them all—to be, in fact, the modes of manifestation of that power.

"Now, why should we not extend this view to histology, which, as we have explained, is only ultimate morphology? As the whole animal is the result of the differentiation of a structureless yelk, so is every tissue the result of the differentiation of a structureless blastema—the first step in that differentiation being the separation of the blastema into endoplast and periplast, or the formation of what is called a 'nucleated cell.' Then, just as in the developement of the embryo, when the blastodermic membrane is once formed, new organs are not developed in other parts of the yelk, but proceed wholly from the differentiation of the blastoderm,—so histologically, the 'nucleated cell,' the periplast with its endoplast, once formed, further developement takes place by their growth and differentiation into new endoplasts and periplasts. The further change into a special tissue, of course, succeeds and results from this primary differentiation, as we have seen the bodies of the vertebræ succeed the chorda dorsalis; but is there any more reason for supposing a causal connexion between the one pair of phenomena, than between the other? The cellular structure precedes the special structure; but is the latter, therefore, the result of a 'cell-force,' of whose existence there is on other grounds no evidence whatever? We must answer in the negative. For us the primarily cellular structure of plants and animals is simply a fact in the history of their histological developement—a histologically necessary stage, if one may so call it, which has no more causal connexion with that which follows it, than the equally puzzling morphological necessity for the existence of a chorda dorsalis or of Wolffian bodies has, with the developement of the true vertebræ or of the true kidneys.

"If this be true, we might expect, as we find, that the differentiation of the germinal disc, for instance, into a primitive groove and lateral portions —the first stage of developement in the embryo of all vertebrate animals—does not occur in mollusks; as we find, again, that the differentiation of the embryo into plumula and cotyledons which occurs in a great number of plants, is absent in others; so, if, like these, the histological differentiation into cells have no necessary causal connexion with the action of the vital forces, but be merely a genetic state, we may expect to meet with cases in which it does not occur. Such, in fact, are the so-called unicellular plants and animals—organisms which often exhibit no small complexity of external form, but present no internal histological differentiation. In the genus Caulerpa we have an Algæ, presenting apparent leaves, stems, and roots, and yet which, according to Nageli, consists of a single cell—that is, is not composed of cells at all. The Vorticellæ furnish us with examples of animals provided with a distinct œsophagus, a muscular pedicle, &c., and yet in which no further histological differentiation can be made out. As Wolff says—

" 'The latter (Roesel's Proteus) has no structure, no determinate figure, and even the indeterminate figure that it has at any given time does not remain the same, but alters continually. We can, in fact, regard all these plants and animals as little else than living or vegetating matters—hardly as organised bodies.'

"'However, all these plants and animals nourish themselves, vegetate, and propagate their species, just as well and as easily as the most artificial pieces of mechanism to be met with in the vegetable or animal kingdom.'

"It is true, indeed, that the difficulty with regard to these organisms has been evaded by calling them 'unicellular'—by supposing them to be merely enlarged and modified simple cells; but does not the phrase an 'unicellular organism' involve a contradiction for the cell-theory? In the terms of the cell-theory, is not the cell supposed to be an anatomical and physiological unity, capable of performing one function only—the life of the organism being the life of the separate cells of which it is composed? and is not a cell with different organs and functions something totally different from what we mean by a cell among the higher animals? We must say that the admission of the existence of unicellular organisms appears to us to be virtually giving up the cell-theory for these organisms. If it be once admitted that a particle of vitalisable matter may assume a definite and complex form, may take on different functions in its different parts, and may exhibit all the phenomena of life, without assuming the cellular structure, we think that it necessarily follows that the cells are not the centres of the manifestation of the vital forces; or that, if they be so, the nature of these forces is different in the lower organisms from what it is in the higher—a proposition which probably few would feel disposed to maintain.

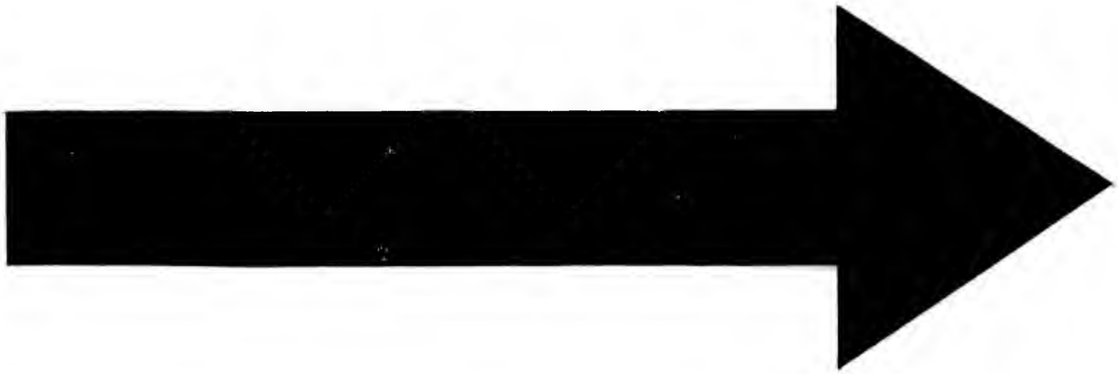
"So much for the critical, and therefore more or less ungrateful, portion of our task. We have seen how the great idea, fully possessed by Fallopius, that life is not the effect of organisation, nor necessarily dependent upon it, but, on the other hand, that organisation is only one of the phenomena presented by living matter—carried to absurdity by Stahl and Van Helmont—has, on the other hand, been too much neglected by the later writers who have attempted to reduce life to the mere attractions and repulsions of organic centres, or to consider physiology simply as a complex branch of mere physics. We have seen how this latter notion has been fostered by the misconceptions of a great botanist, only too faithfully followed in the animal world by the illustrious author of the cell-theory; and we have endeavoured to show how the solitary genius of Wolff had kept in the old track, and that the choice of modern histologists lies between him and Schleiden and Schwann. It will be sufficiently obvious that our own election has long been made in this matter, and we beg to submit the following sketch of a general theory of the structure of plants and animals—conceived in the spirit, and not unfrequently borrowing the phraseology, of Wolff and Von Baer.

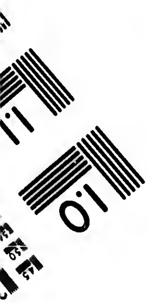
"Vitality, the faculty, that is, of exhibiting definite cycles of change in form and composition, is a property inherent in certain kinds of matter.

"There is a condition of all kinds of living matter in which it is an amorphous germ—that is, in which its external form depends merely on ordinary physical laws, and in which it possesses no internal structure.

"Now, according to the nature of certain previous conditions—the character of the changes undergone—of the different states necessarily exhibited—or, in other words, the successive differentiations of the amorphous mass will be different. Conceived as a whole, from their commencement to their termination, they constitute the individuality of the living being, and the passage of the living being through these states, is called its developement. Developement, therefore, and life are, strictly speaking, one thing, though we are accustomed to limit the former to the progressive half of life merely, and to speak of the retrogressive half as decay, considering an imaginary resting point between the two as the adult or perfect state.

"The individuality of a living thing, then, or a single life, is a continuous developement, and developement is the continual differentiation, the constant cyclical change of that which was at first, morphologically and chemically indifferent and homogeneous.





The morphological differentiation may be of two kinds. In the lowest animals and plants—the so-called unicellular organisms—it may be said to be *external*, the changes of form being essentially confined to the outward shape of the germ, and being unaccompanied by the developement of any internal structure.

"But in all other animals and plants, an internal morphological differentiation precedes or accompanies the external, and the homogeneous germ becomes separated into a certain central portion, which we have called the *endoplast*, and peripheral portion, the *periplast*. Inasmuch as the separate existence of the former necessarily implies a cavity, in which it lies, the germ in this state constitutes a vesicle with a central particle, or a 'nucleated cell.' There is no evidence whatever that the molecular forces of the living matter (the 'vis essentialis' of Wolff, or the vital forces of the moderns) are by this act of differentiation localised in the endoplast, to the exclusion of the periplast, or *vice versâ*. Neither is there any evidence that any attraction or other influence is exercised by the one over the other; the changes which each subsequently undergoes, though they are in harmony, having no causal connexion with one another, but each proceeding, as it would seem, in accordance with the general determining laws of the organism. On the other hand, the 'vis essentialis' appears to have essentially different and independent ends in view—if we may for the nonce speak metaphorically—in thus separating the endoplast from the periplast.

"The endoplast grows and divides; but, except in a few more or less doubtful cases, it would seem to undergo no other morphological change. It frequently disappears altogether; but as a rule, it undergoes neither chemical nor morphological metamorphosis. So far from being the centre of activity of the vital actions, it would appear much rather to be a less important histological element. The periplast, on the other hand, which has hitherto passed under the names of cell-wall, contents, and intercellular substance, is the subject of all the most important metamorphic processes, whether morphological or chemical, in the animal and in the plant. By its differentiation, every variety of tissue is produced; and this differentiation is the result not of any metabolic action of the endoplast, which has frequently disappeared before the metamorphosis begins, but of intimate molecular changes in its substance, which take place under the guidance of the 'vis essentialis,' or, to use a strictly positive phrase, occur in a definite order, we know not why. The metamorphoses of the pleriplastic substance are twofold —chemical and structural. The former may be of the nature either of *conversion:* change of cellulose into xylogen, intercellular substance, &c., of the indifferent tissue of embryos into collagen, chondrin, &c.; or of *deposit:* as of silica in plants, of calcareous salts in animals.

"The structural metamorphoses, again, are of two kinds—*vacuolation*, or the formation of cavities; as in the intercellular passages of plants, the first vascular canals of animals; and *fibrillation*, or the developement of a tendency to break up in certain definite lines rather than in others, a peculiar modification of the cohesive forces of the tissue, such as we have in connective tissue, in muscle, and in the 'secondary deposits' of the vegetable cell. Now to illustrate and explain these views, let us return to the vegetable and animal tissues, as we left them in describing the base of the Sphagnum leaf and fœtal cartilage, and trace out the modification of these, which are identical with all young tissues, into some of the typical adult forms. The point of the Sphagnum leaf is older than the base, and it is easy to trace every stage from the youngest to the complete forms in this direction. At the base of the leaf, we find, as has been said, nothing but minute endoplasts, each resembling the other, embedded in a homogeneous periplastic substance (A); as we trace these upwards, we find, that some of the endoplasts increase in size more rapidly than the others (B), and eventually

Fig. 2.

Portions of the leaf of Sphagnum. A, from the base; B, more towards the point; C, fully formed; *a*, endoplasts which disappear; *b*, those which remain; *c*, spiral thickenings of periplast in the cavities of the former; *d*, apertures formed by resorption.

totally disappear, leaving only the endoplastic cavity, or 'cell,' which contained them. In the surrounding cells, the endoplasts are very obvious as granular primordial utricles (C). After the disappearance of the endoplast, changes commence in the periplastic substance or wall of the cell (*a*), more or less circular or spiral thickenings (*c*) taking place in it, so as to form the well-known fibre-cell of the sphagnum leaf; and at the same time, a process of resorption occurs in particular parts of the wall, so that round apertures are formed (*d*.) Nothing can be more instructive than this case, the leaf being composed of a single layer of delicate and transparent cells, so that there are no interfering difficulties of observation; and we see demonstrated, in the most striking manner, that the endoplast or primordial utricle has nothing to do with the metamorphoses which occur in the periplastic substance. The disappearance of the primordial utricle in cells which are undergoing thickening, was, in truth, long ago pointed out by Von Mohl; but neither he nor any of his successors seem to have noticed how completely this fact does away with that activity of the primordial utricle, and passivity of the cell-wall, which they all assume. We have here, in fact, the cell-wall commencing and carrying through its morphological changes after the primordial utricle has completely disappeared, and we see that the so-called secondary deposit in this case, is a morphological differentiation of the periplast, which at the same time exhibits its peculiar powers by setting up a resorption of its substance at another point. Here, however, we have no marked chemical differentiation; for an instance of which we may turn to the collenchyma of the beet-root (fig. 1, A.). There is no question that, at one period of its developement, the whole periplastic substance here, as in the Sphagnum, was homogeneous, and of the same chemical constitution. In the fully formed beet-root, however, we have no less than three compounds disposed around each cell cavity. The pleriplastic substance has, in fact, undergone both a chemical and a morphological differentiation—the innermost layers (*c*) consisting of ordinary cellulose; the next of a substance which swells up in water (*b*); and the outermost of a different, but not exactly defined, substance (*a*). We may call one of these portions 'cell-membrane,' and another intercullar substance, but they are, assuredly, all nothing but differentiated portions of one and the same periplast.

"Woody tissue presents precisely the same phenomena, the inner layers of the periplastic substance having, very generally, a different composition from the outer.

"Morphologically, we have already noticed the lamination of the periplastic substance, and we may mention its fibrillation, a process which takes place almost invariably in the inner layers of the periplast, and to which the well-known spirality of the so-called secondary deposits must be referred; but a more important process for our present purpose is what we have called Vacuolation; the developement of cavities in the periplastic substance independent of the endoplast, and which, to distinguish them from the cells, may conveniently be termed *Vacuolæ*. In the youngest vegetable tissues there are no such cavities, the periplastic substance forming a continuous solid whole; and it is by this vacuolation, which occurs as the part grows older, that all the intercellular passages are formed, and that many cells obtain that spurious anatomical independence, to which we have adverted above. The exaggerated developement of the vacuolæ in the pith of the rush converts the periplastic substance, with its proper endoplastic cavities, into regular stellate cells. (Fig. 1, B.)

"Sufficient has been said to illustrate the differentiation of the primitive vegetable structure into its most complex forms. If we turn to the animal tissues, we shall find the same simple principles amply sufficient to account for all their varieties.

"In the plant, as we have seen, there are but two histological elements—the periplastic substance, and the endoplasts, cell-wall and intercellular substance, being merely names for differentiated portions of the former; cell-contents, on the other hand, representing a part of the latter. In the animal, on the other hand, if we are to put faith in the present nomenclature, we find the cell-wall, intercellular substance, and cell-contents, forming primitive elements of the tissues, and entering into their composition as such: there have been no small disputes whether the collagenous portion of connective tissue is intercellular substance or cell-wall, the elastic element being pretty generally admitted to be developed from distinct cells. Again, it appears to be usual to consider the fibrillæ of striped muscle as modified cell-contents, while the sarcolemma represents the cell-walls. The hyaline substance of cartilage is asserted by some to be cell-wall, by some to be intercelular substance; while the walls of the epithelium cavities are admitted, on all hands, to be cell-walls. We confess ourselves quite unable to find any guiding principle for this nomenclature, unless it be that the toughest structure surrounding a 'nucleus' is to be taken as cell-wall, any thing soft inside it being contents, and any thing external to it intercellular substance; which is hardly a caricature of the vagueness which pervades histological works upon this subject. This results, we think, from the attempt to determine the homology of the parts of the tissues having been made from the examination of their embryonic conditions, where it is often very obscure, and hardly to be made out. It is another matter if we adopt the 'principle of continuity' of Reichert—a method of investigation which has been much neglected. This principle is simply, that whatever histological elements pass into one another by insensible gradations are homologous and of the same nature; and it is so clear and easy of application, that we can but wonder at its hitherto limited use. We will now proceed to analyse the nature of the constituents of some of the most characteristic tissues in this way, starting from that of embryonic cartilage, as we may have described it above.

"Connecting tissue occurs in two forms,—which, however, pass into one another by infinite gradations,—the solid and the areolated: of the former we may take a tendon as an example; of the latter, the loose areolar tissue, which is found forming the inner layer of the skin and mucous membranes. Fig. 3 represents the junction between the tendo-Achillis and the cartilage of the os calcis, in a young kitten. At A, we have pure cartilage, the endoplasts lying within cavities whose walls present more or less

Fig. 8.

Junction of tendo-Achillis and cartilage of the calcaneum in a kitten. A, pure cartilage; B, intermediate portion; C, tendon. It must be understood that the transition is in reality much more gradual, the different stages having here been approximated for the sake of economising space.

defined contours. At B, the cavities and their contained endoplasts are somewhat elongated, and a faint striation is obvious in the upper portion of the periplastic substance, which becomes stronger and stronger, as we proceed lower down, until it ends in an apparent fibrillation. A chemical change has at the same time taken place, so that in this portion the striated part of the periplast is swollen up more or less by acetic acid, the walls of the cavities remaining unaffected, and thence becoming more distinct; while in the portion A, the whole periplast was nearly equally insensible to this reagent. The portion C, nearest the tendon, and passing into it, is completely tendinous in its structure. The periplast exhibits strong fibrillation, and is very sensitive to acetic acid, while not only the walls of the cavities, but the intermediate periplast, in certain directions, which radiate irregularly from them, have changed into a substance which resists acetic acid even more than before, and is in fact elastic tissue. Compare this process with that which we have seen to be undergone by the collenchyma of the beet-root, and we have the fibrillation of the outer portion of the periplast around each endoplast, and its conversion into collagen, answering to the lamination of the 'intercellular substance,' and its conversion into a vegetable gelatinous matter, while the elastic corresponds with the cellulose inner wall.

"The testimony of numerous observers agree that cartilage is converted into connective tissue in the way described. Professor Kolliker, who unwillingly admits the fact, suggests, nevertheless, that such connective tissue as this, is not true connective tissue, inasmuch as it presents differences in its mode of developement, the collagenous element in the latter being always developed from cells.

"Now, we might be inclined to ask, if the substance of the tendo-Achillis is *not* connective tissue, but only '*täuschend ähnlich*,' what is? But it is better to attack Prof. Kolliker's stronghold, the areolated gelatinous connective tissue, which is, as he justly observes, the early form of fœtal connective tissue generally. If the outer layer of the corium of the skin, or the submucous gelatinous tissue in the enamel organ, be teased out with needles, we shall obtain various stellate or ramified bodies, containing endoplasts (fig. 4) which Kolliker calls cells, and

Fig. 4.

Stellate 'cells' of young connective tissue from the actinenchyma of the enamel organ of the calf.

which, as he states, do assuredly pass into, and become bundles of fibrillated connective tissue. But is this really a different mode of developement from that already described? We think not. Indeed, if that portion of this young gelatinous connective tissue, which lies immediately adjacent to the epidermis or epithelium be examined, it will be found to present a structure in all respects similar to fœtal cartilage, that is, there is a homogenous matrix in which the endoplasts are dispersed (fig. 5 B). If this be traced inwards, it will be found that the endoplasts become more widely separated from one another, and that the matrix in places between them is softened and altered, while in their immediate neighbourhood, and in the direction of irregular lines stretching from them, it is unaltered. This is, in fact, the first stage of that process which we have called vacuolation. In this condition the intermediate softened spots still retain sufficient consistence not to flow out of a section; but yielding, as it does, in these localities, much more readily than in others, it is easy enough to tear out the firmer portion in the shape of 'cells,' which are fusiform, irregular, or stellate; and the whole tissue has therefore been described (Reichert, Virchow, Schwann) as consisting of cells, connected by an 'intercellular substance.' Both 'cell-walls' and 'intercellular substance,' however, are portions of the same periplast, and together correspond with the matrix of the cartilage. When, therefore, in the course of further developement, the 'intercellular substance' becomes quite fluid and so disappears, the outer portion of these cells being converted into fibrillated collagenous tissue, and the inner into elastic substance, we have, notwithstanding the apparently great difference, in reality exactly the same mode of metamorphosis of the same elements, as in the

Fig. 5.

Submucous tissue and epithelium of the tongue of the kitten. A, epithelium; B, young connective tissue.

preceding instance. Connective tissue, therefore, we may say, consists in its earliest state of a homogeneous periplast inclosing endoplasts. The endoplasts may elongate to some extent, but eventually become lost, and cease, more or less completely, to be distinguishable elements of the tissue. The periplast may undergo three distinct varieties of chemical differentiation, *e. g.*, into the gelatinous 'intercellular substance,' the collagenous 'cell-wall,' and the elastic 'cell-wall;' and two varieties of morphological differentiation, vacuolation, and fibrillation—and the mode in which these changes take place gives rise to the notion that the perfect tissue is composed of elements chemically and mechanically distinct.

"The proper understanding of the nature and mode of developement of the component parts of connective tissue is, we believe, of the first importance in comprehending the other tissues. If we clearly bear in mind, in the first place, that the periplast is capable of undergoing modifications quite independently of the endoplasts; and secondly, that in consequence of their modification, elements may become optically, mechanically, or chemically separable from a perfect tissue, which were not discoverable in its young form, and never had any separate existence; many of the great difficulties and perplexities of the cell-theory will disappear. Thus, for instance, with regard to the structure of bone, there can be no doubt that the 'nuclei' of the corpuscles are endoplasts, and that the calcified matrix is the pleriplast. This calcified matrix has, however, in adult bone, very often a very regular structure, being composed of definite particles. To account for these, Messrs. Tomes and De Morgan, in their valuable essay on ossification, which has just appeared, suppose that certain 'osteal cells' exist and become ossified. We have no intention here of entering upon the question of the existence of these 'osteal cells' as a matter of fact, but we may remark, that they are by no means necessary, as the appearance might arise from a differentiation of the periplast into definite and fibrillated aspect. So with regard to the vexed question whether the lacunæ have separate parietes or not, how readily comprehensible the opposite results at which different observers have arrived, become, if we consider that their demonstrability or otherwise results simply from the nature and amount of the chemical difference which has been established in the periplast in the immediate neighbourhood of the endoplast, with regard to that in the rest of the periplast. In fig. 3 substitute calcific for collagenous metamorphosis, and we should have a piece of bone exhibiting every variety of lacunæ, from those without distinct walls, to those which constitute regular stellate 'bone corpuscles.' Finally, in bone, the formation of the 'Haversian spaces' of Tomes and De Morgan is a process of vacuolation, strictly comparable to that which we have described as giving rise to the areolated osseous tissue. Once having comprehended the fact that the periplast is the metamorphic element of the tissues, and that the endoplast has no influence nor importance in histological metamorphosis, there ceases to be any difficulty in understanding and admitting the developement of the tubules of dentine and the prisms of the enamel, without the intervention of endoplasts. These are but extreme and obvious cases in which nature has separated for us two histological elements and two processes, which are elsewhere confounded together.

Fig. 6.

B

Continuity of muscle with connective tissue from the tongue of the lamb. A, Connective tissue; B, muscle.

"One of the most complicated of tissues is striped muscle, yet the true homology of its elements seems to us to become intelligible enough upon these principles. Dr. Hyde Salter has pointed out, that in the tongue the muscles pass directly into the bundles of the submucous connective tissue which serve as their tendons. We have figured such a transition in fig. 6. The tendon A may be seen passing insensibly into the muscle B, the granular sarcous elements of the latter appearing as it were to be deposited in the substance of the tendon (just as the calcareous particles are deposited in bone), at first leaving the tissue about the walls of the cavities of the endoplasts, and that in some other directions, unaltered. These portions, which would have represented the elastic element in ordinary connective tissue, disappear in the centre of the muscular bundle, and the endoplasts are immediately surrounded by muscle, just as, in many specimens of bone, the lacunæ have no distinguishable walls. On the other hand, at the surface of the bundle the representative of the elastic element remains, and often becomes much developed as the sarcolemma. There is no question here of muscle resulting from the contents of fused cells, &c. It is obviously and readily seen to be nothing but a metamorphosis of the periplastic substance, in all respects comparable to that which occurs in ossification, or in the developement of tendon. In this case we might expect, that as there is an areolar form of connective tissue, so we should find some similar arrangement of muscle; and such may indeed be seen very beautifully in the terminations of the branched muscles, as they are called. In fig. 7 the termination of such a muscle, from the lip of the rat, is shown, and the stellate 'cells' of areolated connective tissue are seen passing into the divided extremities of the muscular bundle, becoming gradually striated as they do so.

"We have already exceeded our due limits, and

Fig. 7.

Branched muscle, ending in stellate connective 'cells,' from the upper lip of the rat.

we must, therefore, reserve for another place the application of these views to other tissues. There is, however, one application of the mode of termination of the branched muscles to which we have just referred, which is of too great physiological importance to be passed over in silence. In the muscle it is obvious enough, that whatever *homology* there may be between the stellate 'cells' and the muscular bundles with which they are continuous, there is no *functional analogy*, the stellate bodies having no contractile faculty. But a nervous tubule is developed in essentially the same manner as a muscular fasciculus, the only difference being, that fatty matters take the place of syntonin. Now, it commonly happens that the nerve-tubules terminate in stellate bodies of a precisely similar nature; and these, in this case, are supposed to possess important nervous functions, and go by the name of 'ganglionic cells.' From what has been said, however, it is clear that these may be genetically and not functionally, connected with the nervous tubules, and that, so far from being *the* essential element of the nervous centres and expansions, it is possible that the 'ganglionic cells' have as little nervous function, as the stellate cells in the lip of the rat have contractile function.

"We cannot conclude better than by concisely repeating the points to which we have attempted to draw our attention in the course of the present article.

"We have endeavoured to show that life, so far as it is manifested by structure, is for us nothing but a succession of certain morphological and chemical phenomena in a definite cycle, of whose cause or causes we know nothing; and that, in virtue of their invariable passage through these successive states, living beings have a developement, a knowledge of which is necessary to any complete understanding of them. It has been seen that Von Baer enunciated the law of this developement, so far as the organs are concerned; that it is a continually increasing differentiation of that which was at first homogeneous; and that Caspar Frederich Wolff demonstrated the nature of histological developement to be essentially the same, though he erred in some points of detail. We have found Schwann demonstrating for the animal, what was already known for the plant—that the first histological differentiation, in the embryo, is into endoplast and periplast, or, in his own phrase, into a 'nucleated cell;' and we have endeavoured to show in what way he was misled into a fundamentally erroneous conception of the homologies of these two primitive constituents in plants and animals—that what he calls the 'nucleus' in the animal is not the homologue of the 'nucleus' in the plant, but of the primordial utricle.

"We have brought forward evidence to the effect, that this primary differentiation is not a necessary preliminary to further organisation—that the cells are not machines by which alone further developement can take place, nor, even with Dr. Carpenter's restriction, are to be considered as 'instrumental' to that developement. We have tried to show that they are not instruments, but indications—that they are no more the producers of the vital phenomena, than the shells scattered in orderly lines along the sea-beach are the instruments by which the gravitative force of the moon acts upon the ocean. Like these, the cells mark only where the vital tides have been, and how they have acted.

"Again, we have failed to discover any satisfactory evidence that the endoplast, once formed, exercises any attractive, metamorphic, or metabolic force upon the periplast; and we have therefore maintained the broad doctrine established by Wolff, that the vital phenomena are not necessarily preceded by organisation, nor are in any way the result or affect of formed parts, but that the faculty of manifesting them resides in the matter of which living bodies are composed, as such—or, to use the language of the day, that the 'vital forces' are molecular forces.

"It will be doubtless be said by many, But what guides these molecular forces? Some Cause, some Force, must rule the atoms and determine their arrangement into cells and organs; there must be something, call it what you will—Archæus, 'Bilddungs-trieb,' 'Vis Essentialis,' Vital Force, Cell-force—by whose energy the vital phenomena in each case are what they are.

"We have but one answer to such inquiries: Physiology and Ontology are two sciences which cannot be too carefully kept apart; there may be such entities as causes, powers, and forces, but they are the subjects of the latter, and not of the former science, in which their assumption has hitherto been a mere gaudy cloak for ignorance. For us, physiology is but a branch of humble philosophy of facts; and when it has ascertained the phenomena presented by living beings and their order, its powers are exhausted. If cause, power, and force, mean any thing but convenient names for the mode of association of facts, physiology is powerless to reach them. It is satisfactory to reflect, however, that in this comparatively limited sphere the inquiring mind may yet find much occupation." We think, however, that we may return an answer to the enquiry without identifying life with the "vis essentialis," or any secondo-primary power, and rest satisfied with the simple declaration approved by the reason, that life and matter continue in union by the fiat of an omnipotent power.

Further, Mr. Huxley clearly exposes the fallacy against which we contend. We gather from his views of cell-developement, that these bodies are not to be looked upon as instruments or agents in the process of vitalisation, *i. e.*, producers of vital phenomena; and when we recollect the evidence which they afford of differentiation of organic structure, we cannot but think that Mr. Huxley is in the main correct. Mr. DeMorgan, who opposes these opinions, quotes a passage, which we interpret very differently. Mr. Huxley says, "we have brought forward evidence to the effect that this primary differentiation is not a *preliminary* to further organisation—that the cells are not machines by which *alone* further developement can take place, nor even with Dr. Carpenter's restriction are to be considered as instrumental to that developement. We have tried to shew that they are not instruments, but indicators—*that they are no more* THE PRODUCERS of vital phenomena, than shells scattered along the sea beach in orderly lines, are the instruments by which the gravitative force of the moon acts upon the ocean. Like these, the cells mark only where the vital tides have been, and how they have acted." Arguments will shortly be adduced to prove the doctrine of Dr. Carpenter erroneous; we shall here briefly shew that Mr. Huxley merely declares that cells are not instruments *for manufacturing* vital force; he nowhere says that they are not instruments for preserving or ministering in the economy of organisation; but he denies, and we think correctly, that the cell is the cause of life, the organic originator of life, for "as the whole animal is the result of a differentiation of a structureless yelk, so is every tissue the result of a structureless blastema;* the first step in that differentiation being the separation of the blastema into endoplast† and periplast,‡ or the formation of what is called "nucleated cell." There, just as in the developement, when the blastodermic§ membrane is once formed, new organs are not developed in other parts of the yelk, but proceed wholly from the differentiation of the blastoderm; so, histologically,‖ the "nucleated cell," the periplast with its endoplast once formed, further developement takes place by their growth and differentiation into new endoplasts and periplasts." Mr. Huxley is here evidently contending against the doctrine which declares "substance to be the cause of its attributes;" he denies that the nucleated cell is first formed and then becomes possessed of attributes, manufacturing its own powers, the instrument of its own life; nor does he maintain "that the absorbent gland, for example,

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* *βλαστημα*, growth, production; germ-substance. † *Ενδον*, within; *πλασμα*, that which has been formed. ‡ *Περι*, round about; *πλασμα*, that which has been formed. § Germinal membrane, inclosing liquid yelk. ‖ *Ιστος*, a tissue; *λογος*, discourse.

which is nothing more than a compact plexus of absorbents, containing an abundance of nucleated corpuscles, is not an active agent, because in the lower animals there are no absorbents at all; or that the red-blood corpuscle, which is either cell or nucleus, is not an active agent, because developement goes on, and all kinds of animal and organic functions are performed in the lower animals without its presence; and the doctrine advanced especially declares "that in these and many other instances, the presence of the cell elements is a sufficient proof of some higher, or, at least, some modified manifestation of vital force, of which they are the indication, *as well as the* instruments. They are instruments for the performance of some special function; they are not the instruments of their own existence, or of the vital power by which they act. They are mighty indications of the existence of a vital power which issues with the germ, and which continues with and abides in it through all its stages of subsequent developement. Mr. Paget has advanced the same doctrine in his usual elegant language: "While studying the means by which living bodies, having suffered injury, regain their perfection, we may find continual manifestations of the same mysterious properties of the germ by which, through developement, they first attained it. And in these manifestations we may discern the best evidence, that in developing the body to its perfection, the power of the germ is not lost, or quite exhausted, *but rather is diffused through* all parts of the completed being; and that diffused, it works in them through all their life, determining, as with continuous design, every natural formative process, in accordance with the specific character of the individual. For I believe that we cannot form a just conception of the scope and nature of even the least of the processes of repair and reproduction after injury, or of the maintenance of the body in ordinary nutrition, or of its natural changes in the course of age, unless we admit that each organism, in its perfect state, retains, diffused through all its parts, some of the specific properties from which the power issued that actuated the impregnated germ in its developement." In other words, the power and capacity of developement is an implanted power from the first, and is not dependent for its existence on the machinery which it uses for its manifestation. Is the brain of the young fœtus simply an excretion from the blood, or an evidence of wonderful provision for the future, an indication that the vital power has been operative in providing an instrument for its subsequent wants? It cannot be said that this power acts of itself, as supposed by some ancients, but it does act in accordance with the primary degree, not yet abrogated, which said that the seed should contain within itself the future generations.

Dr. Carpenter testifies that, whatever be the prethe nature and history of the fecundating process, there can be no doubt that the properties of the germ depend upon conditions both material and dynamical, supplied by both parents. This is most obviously shewn by the *fusion* of the characters of the parents, which is exhibited by hybrids between distinct species or strongly marked varieties among the lower animals, such as the horse and ass, the lion and tiger, or the various breeds of dogs; or in the offspring of parents belonging to two strongly contrasted races of men, such as the European on the one hand, and the negro or American Indian on the other. But it is rare to meet with instances, even when the differences between the families are less strongly marked, in which some distinctive traits of both may not be readily traced; these traits shewing themselves *in peculiarities of manner and* gesture, in tendencies of thought or feeling, in proneness to particular constitutional disorders, &c., even where there is no personal resemblance, and where there has been no possibility that these peculiarities should have been gained by imitation. And it is well known, too, that such peculiarities will often re-appear in a subsequent generation, *after being apparently extinct;* as if the agency which produced them, for a time had been overpowered by some stronger influence, but had subsequently been left free to operate. The influence of particular provisions of the regular nutritive operations, brought about by causes to which the parents have been exposed, is often manifested in the offspring; thus we find gout, scrofula, syphilis, &c., hereditarily transmitted; and the children of habitual drunkards are distinguished by their tendency to idiocy and insanity. Mr. Kneeland, of Boston, on this head, reports: "The pre-disposing cause must act during gestation—idiocy may be hereditary: children of besotted parents are very apt to be idiotic. Of this it is needless to quote examples, as the records of idiocy are full of striking proofs of this visiting on the children the sin of their parents. Various shocks to the nervous system of the mother have been known to cause idiocy. Esquirol mentions that, during the exciting period of the French revolution, many women brought forth idiotic children, who before and after that period had healthy ones. The intermarriage of near relatives is very apt to be followed by idiotic children. In 359 cases alluded to by Dr. S. G. Howe, in his state report, 17 were known to be the children of parents nearly related by blood, and doubtless many more should be added. This makes (so far as such few cases go) the proportion of idiots from this cause, one-eighteenth of the whole; and, considering the small ratio such marriages bear to the great mass of marriages, this proportion becomes of more importance. It is said most of the parents were intemperate and scrofulous, some were both the one and the other; of course there were other causes, to increase chances of infirm offspring, besides that of the intermarriage. There were born unto them 95 children, of whom 44 were idiotic, 12 others were scrofulous and puny, one was deaf, and one was a dwarf. In some cases all the children were either idiotic or very scrofulous and puny. In one family of eight children, five were idiotic." Dr. S. M. Bemis, of Kentucky, made a report at the late meeting of the National Medical Association, in Washington, shewing the influence of marriages of consanguinity upon offspring. After giving a variety of statistics, obtained from reliable sources, the Dr. speculates as follows:—" If the same ratio be supposed to exist throughout the Union, there would be found to the twenty millions of white inhabitants, six thousand three hundred and twenty-one marriages of cousins, giving birth to three thousand nine hundred and nine deaf, dumb, blind, idiotic and insane children, distributed as follows:—Deaf and dumb, 1,116; blind, 648; idiotic, 1,854; insane, 290. Then, if the figures of the last United States census, still applied to our population, there would now be found in the Union, 9,136 deaf and dumb, of whom 1,116, or 12.8 per cent., are children of cousins; 7,978 blind, of whom 648, or 8.1 per cent., are children of cousins; 14,978 insane, of whom 290, or 0.19 per cent., are children of cousins.

" If parents and people generally understood the causes that produce idiocy there would be fewer of those poor unfortunates cast upon the world.

"Physiologists have examined the physical condition of the progenitors of idiots, and sought for some satisfactory causes of the very vice or defect in the organisation which causes idiocy.

"Several striking truths seem to be the result of these inquiries. One of the most is, that eight-tenths of the idiots are born of a wretched stock; of families which seem to have degenerated to the lowest degree of bodily and mental condition; whose humors are vitiated, and whose scrofulous tendency shows itself in eruptions, sores, and cutaneous and glandulous diseases. This condition of the body is the result of intemperance, of excesses of various kinds, committed, for the most part, in ignorance of their dreadful consequences. They are lean, nervous, puny, and sore-eyed. They have salt-rheum, king's evil, and kindred afflictions; they cannot digest well, cannot sleep well, and they die young. Their mental and moral condition is as low as their bodily one.

"But of 420 cases of congenital idiocy which were examined in Massachusetts, some information was obtained respecting the progenitors of 359. Now, in all these other, 359 cases, save only four, it was found that one or the other, or both, of the immediate progenitors of the unfortunate sufferer had in some way widely departed from the normal condition of health, and violated the natural laws. That is to say, one or the other, or both of them, had been very unhealthy or scrofulous; or hereditarily predisposed to affections of the brain, causing occasional insanity; or had intermarried with blood relatives; or had been intemperate; or had been guilty of sensual excesses which impair the constitution. The idiotic child is just as much the result of some organic vice or weakness in the constitution of the parent as the sour and crabbed apple is the necessary product of a wild and bad stock.

"A report made to the Senate of Massachusetts, by a Board of Commissioners appointed in 1846, to investigate into the condition of idiots in that State, and to consider the propriety of establishing an asylum or school for them, contains the following:—

"In some families which are degraded by drunkenness and vice, there is a degree of combined ignorance and depravity which degrades humanity. It is not wonderful that feeble-minded children are born in such families; or, being born, that many of them become idiotic. Out of this class domestics are sometimes taken by those in better circumstances; and they make their employers feel the consequences of suffering ignorance and vice in the community. There are cases recorded where servant women, who had the charge of little girls, deliberately taught them habits of self abuse, in order that they might exhaust themselves and go to sleep quietly! This has happened out of the almhouses as well as in them, and such little girls have become idiotic!

"There are, among those enumerated in this report, some who not long ago were considered young gentlemen and ladies, but who are now moping idiots, idiots of the lowest kind; lost to all reason, to all moral sense, to all shame; idiots who have but one thought, one wish, one passion, and that is, the further indulgence of the habit which has loosed the silver cord, even in their early youth; which has already wasted, and, as it were, dissolved the fibrous parts of their bodies, and utterly extinguished their minds.

"For one victim which it leads down to the depth of idiocy, there are scores and hundreds whom it makes shamefaced, languid, irresolute, and inefficient for any high purpose of life.

"In no less than ten cases which are here recorded the idiocy of the children was manifestly attributable to this sin of the parent. Now, if a cause which would be be so carefully concealed, is brought out in these ten cases, in how many more must it have been at work unnoticed and unsuspected.

"How much bodily disease and weakness; how much mental obliquity and imbecility; how much of ungovernable lust, are thrown upon the children of this generation by the vices of their fathers and mothers of the foregoing one.

"The treatment of children at home for idiocy, by giving them medicine and otherwise, generally results in very serious consequences.

"Probably the habitual use of alcoholic drinks does a great deal to bring families into that low and feeble condition of body alluded to as a prolific cause of idiocy. Out of three hundred and fifty-nine idiots, the condition of whose progenitors was ascertained, ninety-nine idiots were the children of drunkards. The general appearance of these idiots is remarkably like that of their parents when they were in their long drunken debauches. The effect of habitual use of alcohol, even in moderate quantities, seems to be to lymphatise the whole bodily organisation; that is, to diminish the proportion of the fibrous part of the body —that which gives enduring strength, and to make the lymphatic or the watery particles to abound in all the tissues. The children of persons so lymphatised are apt to be of the scrofulous character above described; and their children are apt to be feeble in body and weak in mind. Idiots, fools and simpletons are common among the progeny of such persons, either in the first or second generation.

"The use of alcoholic drinks or other stimulants by parents begets an appetite for them in the offspring.

"By giving this as one of the remote causes of idiocy, it is not meant that even in a majority of cases the offspring of marriages between cousins, or other near relations, will be idiotic. The cases are very numerous where nothing extraordinary is observable in the immediate offspring of such unions. On the other hand, there are so many cases where blindness, deafness, insanity, idiocy, or some peculiar bodily or mental deficiency, or a manifest tendency and liability to them, is seen in such offspring that one is forced to believe they cannot be fortuitous. It depends very much upon the health, education, and similarity of disposition or temperament of the parties. Out of 359 cases in which the parentage was ascertained, seventeen were known to be the children of parents nearly related by blood. This would show that more than one-twentieth of the idiots examined are the offspring of the marriage of relations. It is probable that blindness, deafness, imbecility, and other infirmities, are more likely to be the lot of children of parents related by blood than of others. The statistics of the seventeen families, the heads of which, being blood relatives, intermarried, tells a fearful tale.

"Most of the parents were intemperate or scrofulous; some were both the one and the other; of course there were other causes to increase the chance of infirm offspring besides that of the intermarriage. There were born unto them ninety-five children, of whom forty-four were idiotic, twelve others scrofulous and puny, one was deaf, and one was a dwarf. In some cases, all the children were either idiotic or very scrofulous and puny. In one family of eight children, five were idiotic.

"The following is the number of idiots in the several States, according to the census report of 1850 :—

	Whites.	Free Coloured.	Slaves.
"Maine	575	2	—
New Hampshire	350	1	—
Vermont	297	2	—
Massachusetts	186	5	—
Rhode Island	110	4	—
Connecticut	283	4	—
New York	1644	21	—
New Jersey	406	13	—
Pennsylvania	1432	35	—
Delaware	74	14	4
Maryland	275	48	68
District of Columbia	10	3	—
Virginia	891	90	201
North Carolina	615	28	121
South Carolina	249	5	94
Georgia	515	1	148
Florida	28	—	8
Alabama	343	—	133
Mississippi	136	2	34
Louisiana	106	6	62
Texas	93	—	11
Arkansas	103	2	10
Tennessee	756	5	25

Kentucky	796	20	91
Missouri	325	—	32
Illinois	361	2	—
Indiana	925	13	—
Ohio	1344	17	—
Michigan	186	3	—
Wisconsin	92	2	—
Iowa	94	—	—
California	7	—	—
Minnesota	1	—	—
New Mexico	44	—	—
Oregon	4	—	—
Utah	1	—	—
Total	14257	348	1182

"The number of idiots in the United States is considered, by persons who have made statistical research on this subject, as much greater than the result above given, for parents who have an idiot child do not like, and frequently absolutely refuse, to specify the fact to the census takers."

Except it be that the germ receives from its parents the powers it displays, how are we to explain these facts?

There seems good reason to believe that the attributes of the germ are in a great degree dependent, not merely upon the habitual conditions of the parents which have furnished its original components, but even upon the condition which those parents may be at the time of the sexual congress. Of this we have a remarkable proof in the phenomena, well known to the breeders of animals, that a strong mental impression made upon the female by a particular male, will give the offspring a resemblance to him, even though she has had no sexual intercourse with him, a circumstance for which there is no difficulty in accounting, on the hypothesis put forth regarding the dynamical relation of mental states to the organic process. There is no improbability, therefore, in the idea that the offspring of parents, ordinarily healthy and temperate, but begotten in a fit of intoxication on both sides, would be likely to suffer permanently from the abrogation of the reason, which they have temporarily brought upon themselves. There is another class of facts which seem referable to the same category, that, namely, which exhibits the influence of a male parent upon the subsequent offspring of a different parentage; as in the well-known instance of the quagga makes to a succession of colts, both of whose parents were of the species horse, the mare having been once impregnated by the quagga male: and in the not unfrequent occurrence of a similar phenomenon in the human species, as, when a widow who marries a second time, bears children strongly resembling her first husband. Some of these appear referable to the *strong mental* impression left by the first male parent on the female; but there are others which seem to render it more likely that the blood of the female has imbibed from that of the fœtus, through the placental circulation, *some of the attributes which* the latter has derived from its male parent; and that the female may communicate these, with those proper to herself, to the subsequent offspring of a different male parentage. On the whole, then, we seem entitled to conclude *that the attributes of the embryo will be influenced in a most important degree by the entire condition* (as relates both to the organic and the psychical life) *of both parents at the time of the sexual congress.*

Contrasting the opinions here advanced, with those previously enunciated by the London physiologists, we cannot fail to observe the singular contradictions which they involve: first, it is denied that the germ does contain within itself the power necessary to its future developement, and then the admission that the attributes of the embryo will be influenced in a most important degree by the entire condition of both parents.

As another proof why we should entertain the idea of the nature of life as a power, it may be well to shew that what is true of the animal kingdom is no less true of the vegetable: thus, it is remarked by Schouws, that "It is very well known that the seed of any given plant produces another plant, which displays most exactly the external form, the internal structure, and the chemical composition of the parent plant; on this depends the whole idea of the species. If the effect upon our imagination had not been weakened by the constant observation of this fact, it would appear to us one of the greatest miracles of nature. In the seed there exists not the slightest trace of all those parts of the often so complicated structure, the flower—these are formed much later, and yet it is certain that they are formed exactly in that way and in no other. We are able to go even further back: in the seed we see the germ, and in this traces of the root and terminal bud; but if we examine the seed in the flower, in its state of ovule, the germ appears to us, even under the highest magnifying powers, to be composed of a few minute vesicular cells: from these cells all those parts, and no others, must be gradually developed; while minute cells, exactly resembling them, will be developed in another seed, into a plant, perhaps, differing from it as widely as the poles. How there can reside in these cellules, a formative force, tending exactly in the direction thus determined, as though an ideal figure, gradually to be realised, floated before it,—this is to the most deeply initiated naturalist a wonder which he can only marvel at, and not comprehend.

But the marvellousness becomes still more increased when we reflect that this repetition of the forms takes place, not only from the parent-plant to its next successor, but through thousands of generations: for every thing indicates that the forms have been maintained unaltered since the last great disturbance of the earth's surface.

Examples, however, do occur, of deviation from the normal types of species, produced by the agency of man, viz., the varieties which have originated through cultivation in the course of time. The cereals, the fruit-trees, and ornamental plants, offer plenty of examples. We see the dahlia, the pink, and the auricula vary in an extraordinary degree; yet this variation is strictly limited—through all the changes the typical or fundamental form is retained; a stock, vary as it may, never becomes a wall-flower, a dahlia never an aster.

We trust that sufficient proof has been adduced to controvert the doctrine of the passage of an entity from body to body, and to lead to the inference that the affections of matter are as much endowments as any other quality or property which they possess.

It may, at first sight, appear objectionable to use the terms "molecular force," but it does not tie us down to any theory of materialism, and simply expresses what we believe to be fully proved; that matter, and all the properties it possesses, were created and are creations: so that, in ascending the scale of organisation, when we discover matter and the manifestation of immaterial substance conjoined, the reason is convinced that in this higher conjunction the molecular force is a substantial reality, and is endowed with a power of endurance, which is as endless as the self-existent Omnipotence from which it sprang.

Except on such considerations, we know not how to receive the declaration, "Be fruitful and multiply, and replenish the earth; behold I have given you every herb bearing seed, and every tree in which is the fruit of a tree yielding seed. Let the earth bring forth grass, the herb yielding seed *and* the fruit-tree *yielding fruit after his kind*, whose seed is in itself *upon the earth*." It is particularly to these last words that attention is directed, as containing the strength of the law for which we contend, for if we have sufficiently set forth the necessity of an all-wise power, then the simple enunciation, "whose seed is in itself *upon* the earth," has a significance which the unfolding of the plan of nature clearly developes, and presents to reasoning man the fact of the continued operation of the will by which the earth was "let to bring forth." The whole history of the universe, from "the beginning" to the present hour, plainly pourtrays the continual presence of a sustaining and adjusting intelligent cause; whilst the effects produced as plainly declare the wisdom, goodness, and power of that cause. Now, if it has been proved that the progressive movements in the universe have been manifested in the continued unfolding of a general plan of creation, in order by that very differentiation to illustrate its capacity, and fully set forth its perfection ; if it be true—as all nature shews it to be—that no changes have taken place without plainly setting forth the continued maintenance of harmony and elevation in the scale of developement—reached by strict adherence to law and order—then we are justified in declaring that, in the operations and changes which are continually occurring, there is a guiding power in action which has not yet closed the plan, the foundations of which mark the commencement of time, and can only end in eternity. What proof is there that the end of all things has come ? Who has gathered evidence to establish the fact of a *completed creation ?* If the naturalist has not falsified the testimony of the rocks, they do, indeed, bear witness to a future as unmistakeably now, as we know that they did when the deep foundations of the vertebrate skeleton was laid, which, in man, has reached its highest developement. "A retrospect," says Mr. Owen, "of the varied forms of animals, whether modified for aquatic, aerial, or terrestrial life, will shew that, while they were perfectly and beautifully adapted to the sphere of life and exigences of the species, they adhered, with remarkable constancy, to that general pattern or archetype which was first manifested on this planet, as geology teaches, in the class of fishes, and which has not been departed from even in the most extremely modified skeleton *of the last* and highest form which creative wisdom has been pleased to place on this earth; and, as in the beginning, the early skeleton form was prophetic of the later and more perfected type, so, now, the present condition of creation testifies of a yet more perfect future." If, therefore, the geologist and naturalist simultaneously establish, by the most conclusive evidence, that at the present hour laws are in active operation; and if the most superficial acquaintance with the actions every instant going on in the organic and inorganic kingdom, reveal the same truth, we must arrive at the conclusion that the cause of all such actions and changes is as potent now as ever.

Wherein this connexion of matter and life, of body, soul, and spirit consists, cannot be explained; all that we do know is, that all experience points to the existence of a law which impels the earth to "bring forth grass, the herb yielding seed, and the fruit-tree yilding fruit, after his kind, *whose seed is in itself* UPON THE EARTH," and that throughout the animal kingdom the same law is in force. Now although we do not for a moment suppose that "the principle of life," which it is contended constitutes part of all organised beings, is like that "intelligent animal," which Stahl created, or like the Archeus of Van Helmont; yet, we hold with Mr. Paget, that there is proved to be *a power*—nay, more, an essence, a real principle—manifested in the germ, and acting in all essential things like it; for the characteristic property of an impregnated germ is that, when placed in favourable circumstances, all the materials of which it first consists, and all that it appropriates, are developed according to the same method as was observed in the developement of its progenitors: in other words, in conformity with what we may regard as a law of specific character. In all the wonders of developement, that Prof. Owen has detailed, none appeared more marvellous than the constancy, the seeming tenacity of purpose, with which the germ is thus developed to the likeness of its parents—however vast its power of multiplication and increase—however various its metamorphosis, —however far, in some of these changes, it may deviate from the form in which its parents generated it—however near, in some, it may approach the perfect character of another species—or, which is stranger still, however much alike all germs may be in their primal structure and earliest developements —yet, through all these things, *each germ moves*, with unswerving progress, *guided by the same power as created its first parents*, to the formation of a being in which the parental form and properties are reproduced.

Now the constancy of this result, and its little dependence on external circumstances, justify the expression that every impregnated germ has, in itself *and in the properties* (attributes) with which its maker has endowed it, the power to develope itself into the perfection of an appropriate specific form. However mysterious the nature of such properties, we cannot deny their existence, or refuse to recognise a law (in the sense in which we generally use that term) in the regularity with which the power acts that issues from them, when the germ is placed in favourable conditions; and, therefore, it appears that this power is peculiar in its modes of operation: we may specialise it, whenever acting as "the germ power," or "power of the germ," in consideration of its having its apparent origin and intensest action in the germ.

"There are," says Professor Vogel, "two different causes which may be supposed to effect the transition of the blastema in developement; firstly, the cause may be grounded on the nature of the cytoblastema, and the formation may be developed *with the same necessity which, under favourable conditions, compels the separation* of certain crystals from the mother liquid: or secondly, the transition in the developement may be dependent on external conditions, independent *of surrounding parts of the body*, &c. In order to ascertain which of these two hypotheses is deserving of preference, it is requisite that every one should have perfectly clear and distinct ideas on the following points. We must distinguish between the capacity of the cytoblastema in the progress of developement (potentia) and the actual transition (actus). That the capacity for developement *essentially pertains to the cytoblastema* no one will deny. If it depended merely on external influences, then would any substance placed in similar relations undergo the same process of developement—an assumption entirely at variance with experience. *In this respect* the cytoblastema of a morbid product resembles an egg or seed ; *it differs*, however, *in the circumstances of its actual developement*—the transition of the potentia into the actus, being much more dependent on external conditions. Its developement is not merely dependent on the same general conditions as those of the egg, which is developed out of its mother's body, (viz., on the presence of warmth, moisture, and oxygen,) in the majority of cases it is likewise requisite that it should be connected with the body of a living individual." And again, the same author adds : "In the formation of the animal organism from the egg, the share of the cytoblastema is very predominating ; there is contained within it not merely the capacity, but likewise the whole quality of the future formation: in fact, *the whole of the future organism is included in the egg:* external circumstances can hinder, but cannot essentially change it. We must conclude that the formative capacity—which being equally diffused through the egg is impressed on the whole blastema—now acts at special points, and on those individual tissues which have the capability of extending a developement in a suitable blastema, leading to the formation of analagous compounds within its sphere of action ; that is, in its immediate neighbourhood."

If we have discovered, both from experience and from the testimony of philosophers, that it is an impossibility to avoid the idea of power, subsequent investigation no less discloses that power unfolding itself in astonishing manifestations of wisdom, goodness, justice, mercy—in short, as a power capable of all things—absolute perfection. Standing on the birth-place of creation, we may behold matter flash into existence at the bidding of the Absolute One; and now that the fiat has gone forth, now that that Power has passed into action, every progressive movement reveals the incomprehensible, unlimited greatness and majesty of a Being who, omnipotent, omniscient, omnipresent, so orders all his works that they may tell of his greatness and shew forth his wisdom, power, and goodness. Surely an honest enquiry into the works of creation brings to man a conviction that those works have been constructed not only on a plan which has been fashioned and executed by a designer, but that the object of that plan has been to set forth the perfection of that designer. And here we challenge the doctrine of some of our ablest philosophers, but gladly use their statements as furnishing the very best means of refuting the erroneous theories which are so commonly received as solid truth. If we have correctly enunciated the true doctrine which natural history is capable of uttering, we are warranted in drawing the conclusion, that so far as the organic world at least is concerned, method and intelligence preside over its destiny. Beings constructed on a general plan have been specialised in forms and in a manner fully illustrative of the capacity of the contriver, and well adapted to display all the modifications of which the primary plan is susceptible; and further, that the modification and extension of the plan have rendered evident the continued operation of that original power which summoned them into being. In the whole circle of organisation, as well as in the arrangements and re-arrangements of the inorganic masses, dependence and inter-dependence is unmistakeably apparent. "All things are double, one against another, and God hath made *nothing imperfect*." However evident, then, the power of perfecting itself and its kind be in the innumerable differentiations which the general plan has passed through, we fail to notice the operation of any inherent force of any secondary power at all adequate to account for the known and discoverable changes which in the first place can initiate life movement, or control the forces of nature. The introduction of novel forms is evidently but the progressive unfolding of the scheme which was laid down in the beginning, and which proves most conclusively that to preserve the harmony which exists between the various parts of the universe, nothing but intelligence can guide the movements of bodies not necessarily dependent on each other. Blot out the life on the earth, and it would be re-constructed and go on afresh: the world's position to the heavenly bodies remain obedient to the same laws as when in primeval nakedness its granite crust as yet refused to nurse the humblest weed. If there is such dependence between the varied parts of creation as to establish that sort of connexion which declares that perfection is in that particular way *best* attained, then we can no longer refuse to believe that, although the *general plan* may not be capable of self-developement—would never be able to modify itself, yet that the author of the plan will, at the right time and in the right place, bring about those modifications which are necessary to its amplification and explication—introducing modifications having reference not only to the organisms so diversified, but also to the inorganic elements which surround them; "for each epoch was characterised by some peculiar forms of animal and vegetable life which existed in it alone"—these forms, too, foreshadowing the advent of beings which were to pourtray in their natures qualities which were then combined, and which should re-appear at some future time: thus, it is well known that "near the commencement of the tertiary epoch, remains of pachydermata are found in abundance; but these were for the most part different from those of the present epoch, containing combinations of characters which are now *distributed* among several distinct families, and presenting also a closer approximation to the herbiverous cetaceans on the one hand, and to the ruminants on the other, than is exhibited by any existing species of the order." While, therefore, we admit as true that each differentiation of life is particularised by *special* phenomena affecting the whole nature of the creature, and stamping it with individuality, yet we are equally forced to acknowledge that this very specialisation has invariably been marked and brought about by direct interposition. "In examining," observes Mr. B. Jukes, "the fossils from the earliest rocks, the species and, for the most part, the genera, and even the families, are entirely different from any now living. Still, though different, they are yet so nearly allied to them, as to be capable of being placed in the same great classes, often even in the same orders of organisation as the existing species and genera are grouped in. When we look at the fossils of newer and newer rocks, we find some of these genera and families, and one or two of the orders, very soon disappearing: they are not only extinct now, but they were extinct long before others came into existence which are now equally extinct. This happens not once only, but frequently, as we examine the series of fossil groups.

But together with these short-lived orders, families, and genera, there occur species, chiefly mollusca, which are so nearly allied to some now living, as to receive the same general names, such as nautilus, turbo, natica, terebratula, rhynconella, etc.: these existing generic groups become more and more numerous, until at length the existing become more numerous than the extinct genera, and at last even two or three species *make their appearance*, which are obviously identical with still existing species. More and more, then, of these existing species come to light in still newer rocks, at first associated with a vast majority of extinct species, but gradually attaining the preponderance, until in the newest works of all we find all the mollusca belonging to existing species, and only extinct species of the higher orders of animals.

"One result," observes M. Agassiz, "stands now unquestioned: the existence during each great geological era of an assemblage of animals and plants differing essentially from each period; and by period is meant those minor sub-divisions in the successive sets of beds of rocks, which constitute the stratified crust of our globe, the number of which is daily increasing, as our investigations become more extensive and more precise. In order to be able to compare the succession of the animals of the past ages with some other prominent traits of the animal kingdom, it is necessary to make a few remarks on this topic. In Pictet's Palæontology we have arranged in zoological order, in which every one may at a glance see how, throughout all classes of the animal kingdom, the different representatives of each in past ages are distributed in the successive geological formations. From such a cursory survey, it must appear that while certain types prevail during some periods, they are entirely foreign to others. This limitation is conspicuous, with reference to entire classes among vertebrata, while in other types it relates more to orders, or to the families, and extends frequently only to the genera or to the species."

But whatever be the extent of their range in time, all these types bear, as far as the order of their succession is concerned, the closest relation to the relative rank of living animals of the same types, compared with one another, to the phases of the embryonic growth of these types in the present day, and even to their geographical distribution upon the present surface of our globe. Among echinoderms the crinoids are, for a long succession of periods, the only representatives of that class; next follow the star-fishes, and next the sea-urchins, the oldest of which belong to the type of cedaris and echinus; then follow clypeastroids and spatangoids. No satisfactory evidence of holothuria has yet been found. Among crustacea a comparison of the splendid work of Barrande upon the silurian system of Bohemia, with the paper of Count Munster upon the crustacea of Solenhofen, and with the work of Desmarest upon fossil crabs, will at once shew that while trilobites are the only crustacea of the oldest palæozoic rocks, there is found in the jurassic period a fauna entirely composed of macrura, to which brachyura are added in the tertiary period. The formations intermediate between the older palæozoic rocks and the Jura contain the remains of other entomastraca, and later of some macrousa also. In both classes the succession of their representatives, in different periods, agrees with their respective standing, as determined by the gradation of their structure.

Among plants, we find in the carboniferous period, prominently, ferns and lycopodiaceæ; in the triassic period equisetaceæ and conifera prevail; in the jurassic deposits, cycadeæ and monocotyledoneæ; while later, only dicotyledoneæ take the lead. The econographic illustration of the vegetation of past ages, has of late advanced beyond the attempts to represent the characteristic features of the animal world in different geological periods.

Without attempting here to characterise the order of succession, this much follows already from the facts mentioned, that while the material world in its elements is ever the same through all ages in all its combinations, as far back as direct investigation can trace its existence; organised beings, on the contrary, transform these same materials into ever new forms and new combinations. The carbonate of lime of all ages is the same carbonate of lime in form as well as in composition, as long as it is under the action of physical agents only. *Let* LIFE *be introduced* upon earth, and a polyp builds its coral out of it, and each family, each genus, each species, a different one and different ones for all successive geological epochs. Phosphate of lime in palæozoic rocks, is the same phosphate as when prepared artificially by man; but a fish makes its spines out of it, and every fish in its own way: a turtle its shield, a bird its wings, a quadruped its legs, and man—like all vertebrates—his whole skeleton; and during each successive period in the history of our globe, these structures are different for different species. What similarity is there between these facts? Do they not plainly indicate the working of different agencies, excluding one another? Truly the noble frame of man does not owe its origin to the same forces which combine to give a definite shape to the crystal. And what is true of carbonate of lime, is equally true of all inorganic substances; they present the same characters in all ages past, as those they exhibit now.

Let us look upon the subject, now, in another light, and we shall see that the same is also true of the influence of all physical causes. Among these agents, the most powerful one is certainly electricity; the only agent to which, though erroneously, the formation of animals has ever been directly ascribed. The effects it may now produce it has always produced, and produced them in the same manner. It has reduced metallic ores and various earthy minerals and deposited them in crystalline form, in veins, during all geological ages; it has transported these and other substances from one point to another in times past, as we may do now in our laboratories under its influence. Evaporation upon the surface of the earth, has always produced clouds in the atmosphere, which, after accumulating, have been condensed in rain showers in past ages as now. Rain-drop marks in the carboniferous and triassic rocks, have brought to us this testimony of the identity of the operation of physical agents in past ages, to remind us, that what these agents may do now they already did in the same way, in the oldest geological times, and have done at all times. Who could, in presence of such facts, assume any causal connexion between two series of phenomena, the one of which is ever obeying the same laws, while the other presents at every successive period new relations, an ever changing gradation of new combinations, leading to a final climax with the appearance of man? Who does not see, on the contrary, that this identity of the products of physical agents in all ages, totally disproves any influence on their part in the production of those ever changing beings which constitute the organic world, *and which exhibit,* *as a whole, such striking evidence of connected thoughts.*

The study of the geographical distribution of animals now living upon earth, has taught us that many species of animals and plants have a fixed home, and even that peculiar types may be circumscribed within definite limits upon the surface of our globe. But it is only recently, since geological investigations have been carried into remote parts of the world, that it has been ascertained that this special localisation of types extends to past ages. Lund, for the first time, shewed that the extinct fauna of the Brazils, during the latest periods of a past age, consists of different representatives of the very same types now prevalent on that continent. Owen has observed similar relations between the extinct fauna of Australia and the types now living on that continent; and adds, "that additional facts, and the means of extending our comparisons, by the collection of the fossils of distant lands, are most desirable, in order to precisely define the laws of the geographical distribution of the mammalia of the older and newer pliocene periods; and to speak of the sum of the present observations under the term law, may, perhaps, be deemed premature. But the generalisation first enunciated in my Report to the British Association in 1844, seemed to be sufficiently extensive and unexceptionable, to render them of importance, in a scientific consideration, of the present distribution of the highest organised and last created class of animals; and to shew that, with extinct as with existing mammalia, particular forms were assigned to particular provinces, and what is still more interesting and suggestive, that the same forms were restricted to the same provinces at the pliocene periods as they are at the present day."

Australia, at present, almost exclusively the home of marsupials, has yielded also a considerable number of equally remarkable species, and two extinct genera of that type. Without entering on debatable ground, it remains evident, that before the establishment of the present state of things, peculiar types of animals, which were formerly circumscribed within definite limits, have continued the same on similar grounds in the present period, *even though no* genetic connexion can be assumed between them, their representatives in these different formations *not even belonging to the same genera.* Such facts are in the most direct contradiction with any assumption that physical agents could have any thing to do with their origin; for though their occurrence within similar geographical areas might at first seem to favour such a view, it must be borne in mind that these so-localised beings are associated with other types which have a much wider range; and, what is still more significant, they belong to different geological periods, between which great physical changes have taken place.

Thus the facts indicate precisely the reverse of what the theory assumes ; they prove a continued similarity of organised beings, during successive geological periods, notwithstanding the extensive changes in the prevailing physical conditions which the country they inhabited may have undergone at different periods. In whatever direction this theory of the origin of animals and plants, under the influence of physical agents, is approached, it can nowhere stand a critical examination. "*Only the deliberate intervention of an Intellect, acting consecutively, according to one plan, can account for phenomena of this kind.*"

Without entering into a discussion respecting the precise limits within which this fact is true, there can no longer be any doubt, that not only species, but all groups of animals and plants, have a definite range of duration, as well as individuals. The limits of this duration, as far as species are concerned, generally coincide with great changes in the physical condition of the earth's surface ; though, strange to say, most of the investigators who would ascribe the origin of organised beings to the influence of such causes, maintain, also, that species may extend from one period to another, which implies that these are not affected by such changes.

When considering in general the limitation of species to particular geological periods, we might very properly disregard the question of the simultaniety of the successive *appearance* and disappearance of fauna, as in no way affecting the results of the investigation, as long as it is universally conceded that there is no species known, among the fossils, which extends through an indefinite series of geological formations. Moreover, the number of the species still considered as identical in several successive periods, is growing smaller and smaller, in proportion as they are more closely compared. It has already been shewn, long ago, how widely many of the tertiary species, long considered as identical with living ones, differ from them, and also how different the species of the same family may be, in successive sub-divisions of the same great geological formation. Hall has come to the same result, in his investigation of the fossils of the State of New York. Every monograph reduces their number, in every formation. Thus, Barraude, who has devoted so many years to the most minute investigation of the trilobites of Bohemia, has come to the conclusion that their species do not extend from one formation to the other. D'Orbigny and Pistet have come to the same conclusion for the fossil remains of all classes. It may well be said, that as fossil remains are studied more carefully, in a zoological point of view, the supposed identity of species, in different geological formations, vanishes gradually more and more; *so that the limitation of the species in time*, already ascertained in a general way, by the earlier investigation of their remains in successive geological formations, is circumscribed step by step within narrower, more definite, and also more equable periods. *Species are truly* limited in time, as they are limited in space on the surface of the globe. The facts do not exhibit a gradual disappearance of a limited number of species, and an equally gradual introduction of an equally limited number of new ones; but, on the contrary, *the simultaneous creation and the simultaneous* destruction of entire fauna, and a coincidence between these changes in the organic world, and the great physical changes our earth has undergone. Yet it would be premature to attempt to determine the extent of the geographical range of these changes, and still more questionable to assert their synchionism upon the whole surface of the globe, in the ocean and upon dry land.

To form adequate ideas of the great physical changes the surface of the globe has undergone, and the frequency of these modifications of the character of the earth's surface, and of their coincidence with the changes observed among the organised beings, it is necessary to study attentively the works of Elie de Beaumont. He, for the first time, attempted to determine the relative age of the different systems of mountains, and shewed, first, also, that the physical disturbances occasioned by their upheaval coincided with the successive disappearance of entire fauna, and the re-appearance of new ones. In his earlier papers he recognised seven, then twelve, afterwards fifteen such convulsions of the globe; and now he has traced more or less fully and conclusively the evidence that the number of these disturbances has been at least sixty, perhaps one hundred.

But while the genesis and genealogy of our mountain systems were thus illustrated, palæontologists, extending their comparisons between the fossils of the different formations more carefully to all the successive beds of each great era, have observed more and more marked differences between them, and satisfied themselves that fauna also *have been more frequently renovated* than was formerly supposed; so that the general results of geology proper and palæontology concur in the main to prove, that while the globe has been at repeated intervals, and indeed frequently, though after immensely long periods, altered and altered again, until it has assumed its present condition, so have also animals and plants, living upon its surface, *been again and again extinguished* and *replaced by others*, until those now living were called into existence with man at their head. The investigation is not in every case sufficiently complete to show any where a coincidence between this renovation of animals and plants, and the great physical revolutions which have altered the general aspect of the globe; but it is also already extensive enough to exhibit a frequent synchionism and correlation, and to warrant the expectation that it will, in the end, lead to a complete demonstration of their mutual dependence, *not as cause and effect*, but as steps in the same progressive developement of a plan which embraces *the physical* as well as the *organic world*. Further, recent investigations in palæontology have led to the discovery of relations between animals of past ages and those now living which were not even suspected by the founders of that science. It has, for instance, been noticed, that certain types which are frequently prominent among representatives of past ages, combine in their structure peculiarities which, at later periods, are only observed separately in different distinct types. Sauroid fishes before reptiles, pterodactyles before birds, icthyosauri before dolphins, &c.

There are entire families, among the representatives of older periods, of nearly every class of animals, which, in the state of their perfect developement, exemplify *such prophetic* relations, and afford within the limits of the animal kingdom, at least, the most unexpected evidence, that the plan of the whole creation had been *maturely considered long before it was executed*. Such types may be called prophetic types. The sauroid fishes of the past geological ages are an example of this kind. These fishes, which have preceded the appearance of reptiles, present a combination of ichythyic and reptilean characters not to be found in the true members of this class, which form its bulk at present. The pterodactyles, which have preceded the class of birds, and the icthyosauri, which have preceded the appearance of the crustacea, are other examples of such prophetic types.

The admirable and accurate description of the "Life of a Hair," as drawn by Mr. Paget, illustrated well that special adaptation of life and form which the naturalist proves to have governed the developement of organised beings from their very earliest creation; but further than this, we now have demonstrative proof, that to each organic germ has been assigned a law of developement by which the creature has been ordained to fulfil its destiny, to maintain itself, and to reproduce its kind. No physical agencies are discovered potent to the task of developing either a rodent, an edentate, or herbivorous cetacean from toxodon platensis; it was brought into being a composite animal, typifying the coming of creatures which should separately display in perfection the conjoined attributes of its own nature; and having in its allotted time accomplished its purposed end, it dies out, and leaves its place to be supplied by those whose appearance is in like manner necessary to the progression of the creative plan. But so far we have been unable to discover that the plan which has been originally laid down is in any degree capable of extending itself: dependent for its completion on other conditions than those which it originally received, and which pertain to the immediate welfare and perpetuation of the several parts of which it is made up: adjustment, reconstruction, and construction of special elements, are constantly necessary; and amid all the various interpositions which have occurred in the process of extension, not one single failure has been detected, not a blot to mar the prophetic history which each race proclaimed of those that were to come after.

If, in considering the organic creation merely in relation to its "life movements," we detect enough to satisfy the reason that creative intelligence has originated it, perhaps we may find as strong arguments for the immortality of the life of man. By meditating on the extraordinary gift which he alone of earth-begotten beings possesses—the gift of a moral nature, a nature capable of enjoying and working out the highest moral excellencies—we come on a class of actions which are comprehensible only on the idea of their being those of a creature whose destiny is eternity. For if the life of man be limited to the sphere of earth, it is manifest that of all creatures he is and must be the most miserable: the purest desires of his mind, the loftiest aspirations of his soul, are but so many delusions to cheat and even to torment him; but analogy forces upon him the conviction, that it is with him as with the rest of the great scheme of creation; and from the position in that scale which he occupies, he looks back, and finds ascending approaches to perfection, and from the imperfections which he discovers in his own moral state—*not* in his physical so much—is persuaded that yet a step higher must he ascend, ere he can gain a position which shall place him in the enjoyment of satisfying bliss. Guided by conscience and reason, he rises, not without an effort, to the contemplation of Excellence, and brought within the influence of the pure atmosphere in which it dwells, contemplates with wonder and astonishment the spotless purity, the unsullied life of "the Pattern Man:" in that character all perfection is manifested, and the highest dreams of the heathen or christian philosopher realised. What the object and what the end of all this true greatness, if it be possible to conceal it in the dark and narrow tomb? "Intus in domicilio cogitationis, nec Hebræa, nec Græca, nec Latina, nec Barbara veritas."—*Confess. St. Augustine.*

BOOK II.

Can we obtain evidence of there having been special acts of creation at different times—new beings created and introduced into the world—at new and particular epochs? By the enquiry we shall be enabled to ascertain whether any act of interposition in the progress of creation has taken place; and, should this prove to be the case, whether the act was accomplished of set purpose, in accordance with evident intention and design.

It has already been stated that we believe proof exists to shew that the creation of the world, as generally accepted, is erroneous, and is not at all in accordance with the narrative which has been handed down to us by the inspired Moses.

Before, however, we proceed to sum up the proofs of special acts of creation which have undoubtedly occurred, let us direct our attention to the true interpretation which should be put on the language of the first few verses of the first chapter of Genesis. It has been shewn by Prof. E. B. Pusey, that in some old editions of the English Bible, where there is no division into verses, there is actually a break at the end of what is now the second verse; and in Luther's Bible (Wittenburg, 1557) there is, in addition, the figure 1 placed against the third verse, as being the beginning of the account of the Creation on the first day. We are at a loss to understand how any one can doubt that this must be the true reading, for, on any other, the opening declaration is unintelligible ; examine the verses :—

"In the beginning God created the Heavens and the Earth.

"And the Earth WAS without form, and void.

"And Darkness was on the face of the DEEP.

"And the Spirit of God moved on the face of THE WATERS."

Now, we suppose, that it will cheerfully be conceded that Moses was delivering a history of events, which were applicable especially to man, and intended to apply immediately to him; we may, therefore, without any violence to propriety, suppose him to deliver to us the truth, in language as short and concise as possible, and, perhaps, rendered still more indefinite through the fault of translation. According to the true import of the original, and certainly in accordance with the further light which observation throws on the history, we may take the actual meaning to be,—

In the beginning God created the Heavens and the Earth ; but at the time when man was to be created, the Earth was without form, and void, (desolate and empty,) and darkness was on the face of the deep. In *such a state there was, necessarily, darkness: mist and thick vapour hung over the surface as a shroud, and not a ray of light penetrated the vaporous mass; the earth was beneath the waters.*

To render such a chaos fit for the abode of beings such as are now found upon its surface, a very wonderful change was necessary, and, as of primary importance, the atmosphere must first be purified. In accomplishing this, the Creator of all things, in the majesty of his power, commands the light to shine through the darkness: "Let there be light, and there was light." The abruptness of this fiat tells of its origin, and further points to an active and authoritative preparation of the earth's atmosphere, and the whole subsequent narrative speaks the same language. We read that this work was accomplished in six days. Prof. Buckland, in his well known Bridgewater Treatise, has, in maintaining such opinions, declared the Mosaic record to be correct, and teaches us how we may confidently adhere to the undoubtedly true meaning of the Holy Book, that six literal days are intended, and are the true and only measures of time employed by the Deity in his work. Nothing, certainly, has, since Dr. Buckland's writing, occurred to invalidate his opinion; nor is there a title of evidence to induce us to waver from the doctrine which he endeavoured to establish. "Thus," as he says, "in the second verse we have a distinct mention of the earth and *waters*, as already existing and involved in darkness ; their condition, also, is described as a state of confusion and emptiness (tohu bohu), words which are usually interpreted by the vague and indefinite Greek term, 'chaos,' and which may be geologically considered as designating the wreck and ruins of a former world." At this intermediate point of time, *the preceding undefined geological period had terminated;* a NEW series of events commenced, and the work of the first morning of THIS NEW CREATION was the *calling* forth (not the making) of light, to dispel a darkness which had overspread the ruins of the ancient earth.

We have further mention of this ancient earth and sea in the ninth verse, in which the waters are commanded to be gathered together into one place, and the dry land to appear ; this dry land being the same earth whose material creation had been announced in the first verse, *and whose temporary* submersion and temporary darkness are described in the second verse. "Let the dry land APPEAR," is the command, and not "Let the dry land be made," for it already existed. The *appearance* of the land, and the *gathering* together of the waters, are the only facts affirmed respecting them in the ninth verse ; but neither land nor waters are said to have been created on the third day.

A similar interpretation may be given of the fourteenth and four succeeding verses ; what is here spoken of the celestial luminaries seems to be spoken solely with reference to our planet, and more especially to the human race, then about to be placed upon it. We are not told that the substance of the sun and moon were first called into existence upon the fourth day; for, *let there be light*, by *Yehi aor* by no means necessarily imply any more than the English words by which they are translated, that light had never existed before. The text may equally imply that these bodies were then prepared or appointed to certain offices of high importance to the human epoch, "to be for signs, and for *seasons*, and for days, and for years," which purposes they do fulfil now, and need not necessarily have fulfilled in the same way before.

In Mr. Kitto's Scripture Readings, Ed., 1857, we find the following corroboration of Dr. Buckland and Dr. Pusey's rendering: "*Let there be light, and there was light.*" Striking and magnificent as these words are in the current version, their native force is much weakened by dilution. Here are eight words to translate four of the original. The Hebrew expressed in English characters, is YEHI AOR, VA-YEHI AOR, the letters being exactly alike in the two clauses, with the sole exception of the letter prefixed to the third word to express *and.* The Latin version expresses the grand words with almost the force and brevity of the original, "sit lux, et lux fuit." The Greek version of the Septuagint is not equal in either of these qualities to the original or to the Latin, and yet it was from this version that the critic Longinus derived his impression—a heathen's impression of their surpassing beauty and majesty. The greatest apparent difficulty arises from the creation of light on the first day: whereas, in the sequel of the narrative, the *creation* of the sun and moon seems to be ascribed to the fourth day. Geology, which was at first regarded as increasing the difficulties of a solution, may now claim the credit of having pointed out the true sense in which these intimations are to be received. If we admit that the earth existed, and was replenished with successions of animal and vegetable life, and that the whole was reduced to that desolate state in which we find it, before the work of re-organisation commenced; we must allow, also, that the light of the sun shone upon it in those more ancient days. The earth existed as the result of an anterior creation, with all its previous and interim geological arrangements and fossil remains; but strangely convulsed and fractured, submerged in water, and enshrouded in darkness. Thus it lay, probably, for a very long period, or, it may be, only a short time, for in neither case is the question of interference affected; life was extinct, but matter continued subject to the same laws with which it had been originally endowed: the same attraction, the same repulsion, the same combination of forces, which, by the will of God, have ever been inherent in it, still existed. A vast body of water, surrounding the earth, in the course of time furnished a prodigious mass of dense and dark vapours, which were held suspended in the atmosphere, and threw a pall of blackest night around the globe. All things beneath became invisible, and no ray of light could pierce the thick canopy of continuous night. Layer upon layer of darkling clouds filled the atmosphere, and, in the fullest extent, justified the language of Scripture, " there was darkness on the face of the deep." But when God saw fit, in the fulness of time, to commence a new creation, and prepare the desolate earth for the abode of a special order of beings, to be associated, too, with man, the dense barrier, which shut out light, began, at His high command, to disperse ; His word rolled back the curtain, and let in light upon a hitherto darkened world. It was not likely to be, nor was it necessary to be, a sudden change from the depth of utter darkness to the blaze of sunny day, but the letting in of light without sunshine ; the source of this light —the body of the sun—not becoming visible until the fourth day, when its full glory was disclosed, and its beams once more shone through the purged atmosphere, upon mountains and valleys, seas and rivers, as of old. The sun and moon were not, of course, simultaneously, but successively, disclosed : and the moon first, because the fourth day, in which both appeared, was, like the other days, composed of the night with the following day. If the sun had first appeared, the day would have closed when the sun set, and then the appearance of the moon on the following night would have belonged to another day. But, seeing that they appeared both on the fourth day, and that the days are reckoned from evening to evening, and not from morning to morning, we may be sure that it was the moon whose rays first shone through on the new earth. If man had then existed on the earth, the appearance of "the pale regent of the night" would have prepared his mind and his eye for the glory of that greater light which the day was to disclose. It is further to be observed, that the word "made" is not the same in the Hebrew as that translated "created." It is a term frequently employed in Scripture to signify "constituted, appointed, set for a particular purpose or use." Thus, it is said, "that God *made* Joseph a father to Pharaoh: *made* him lord over Egypt: *made* the Jordan a border between the tribes: *made* Daniel the head of the heathen;" and so in numerous other examples. A critic, whose learning claims the respect which cannot be always allowed to his opinions, says, with regard to the clause, "Let there be lights in the firmament," &c. "The words 'Let there be,' are, in my conception, equivalent to 'Let there appear;' and, if I had allowed myself the freedom which some modern translators have taken, I should thus have rendered the verse : 'Let the luminaries, which are in the expanse of the heavens, be for the purpose of illuminating the earth,'" *etc.* Let it be borne in mind that this author (Dr. Geddes) wrote before science had established a necessity for the *pre-existence of the heavenly bodies.* Thus, therefore, as it has been well remarked by Bush, "As the rainbow was made or constituted a sign, though it might have existed before, so the sun, moon, and stars may be said to have been made or set as lights in the fourth day, though actually called into existence previously. The same result had been, indeed, really effected by the same means during the previous three days and nights ; but these luminaries were henceforth, by their rising and setting, to be the visible means of producing this separation or succession." Another recent writer observes : "I think the sun and moon were made long before *our* earth." But the language of the sacred penman does not teach that God then made the sun and moon : for the words in the original are not those usually rendered *made* and *created;* they might be translated, as it has been shewn by the best Hebrew scholars—in fact they must be so : "Let the lights in the firmament of heaven be for the purpose of dividing the day from the night." The word for create, is *bara ;* the other word that is used for *making*, is *aasa :* but the sacred penman does not, in this instance, use either of these words. He does *not say*, "Let these lights be created," using *bara;* or, "Let these lights be made," using *aasa;* but *Yehi*, "Let them be for the purpose of dividing the day from the night." In fact, the passage recognises their previous existence, and only assigns them a new and resuscitated function, to give light —the one by day and the other by night—and to be "*for signs* and *for seasons*:" to whom? surely not for signs to creatures who had not the gift of reason? but for signs to one yet to be, to a reasoning being, Man, who could appreciate these signs, and turn them to fit use, even as guides to traverse the pathless deep, confident that his way was sure! hence a new office is truly assigned them, for they are indeed signs, as the astronomer and sea-faring man well know. Prof. Hirschfelder has given the following, as the result of his researches :—

"This language, 'And the earth was without form, and void,' may, at the first glance, appear to the ordinary reader perfectly plain; but when we come to examine it more closely, we discover it to be altogether incomprehensible, and that any exposition founded thereon must necessarily be unintelligible, as it is not easy to conceive how any thing material can possibly subsist '*without form.*' It matters not whether the verb *bara*, in the preceding verse, be taken in the sense *he formed*, and be explained as having reference to the earth being formed from some pre-existent material into its present shape, as is held by some commentators; or whether it be taken in the sense, *he created*, and applied to its having been then first created out of nothing, as is maintained by others; in either case, after the earth had been so formed or so created, it must have had some kind of form. The difficulty, however, is entirely removed when we appeal to the original Hebrew, where we read, 'And the earth was (*thohoo vavohoo*),' lit., desolateness and emptiness—*i. e., desolate and empty*, or without covering of any kind; abstract nouns being often employed in Hebrew instead of adjectives. The meaning of the passage now becomes perfectly obvious:—The earth, after its creation, was *desolate and empty*, inasmuch as no organised beings existed upon it,—they had not yet been summoned into being, or made, by the Creator. The English version has been followed by the French, 'sans forme et vide,' and these alone have given '*without form and void.*' As, for instance, the Targum of Onkelos gives 'tzadya v'rekonya,' *i. e., desolate and empty;* the Syriac, 'thooh v'booh,' *i. e., desolate and empty;* the Vulgate, 'inanis et vacua,' *i. e., empty and void;* the German, 'wüste und leer,' *i. e., desolate and empty;* the Italian, 'una cosa deserta e vacua,' *i. e., a thing uninhabited and empty;* the Spanish, 'desnuda y vacia,' *i. e., bare and empty.* Very singular and quite inadmissible is the rendering of the Septuagint, '*ἀόρατος καὶ ἀκατασκεύαστος*,' *i. e., invisible and unfinished.*"

Now, to illustrate the fact of creative interference, and to substantiate the general truthfulness of the Mosaic record, we must appeal to geology, in order to ascertain whether the earth has been renovated at various epochs, and its climatal condition entirely changed, in conformity *with the peculiar life forms* which have lived during given times; furnishing evidence of adjustment, which the most daring believer in the marvellous cannot suppose to have arisen from chance or a blind necessity. Sir R. Murchison, in his Siluria, admirably illustrates the subject: "Passing over the earliest stages of the planet, which are necessarily involved in obscurity, we begin with the first attainable evidence of the formation of sediments, composed of mud, sand and pebbles. It was shewn that the lowest accessible of these deposits, though of enormous dimensions, and occasionally less altered than strata formed after them, are almost entirely *azoic*, or void of traces of inhabitants of the seas in which they were accumulated. One solitary genus of zoophytes has been alone detected in such bottom rocks; the heat of the surface, during those early periods, having been, it is supposed, adverse to life. Proofs there are that, in the next formations, scarcely differing at all in mineral character from those that preceded them, observers in various regions had detected clear and unmistakeable signs of a contemporaneous appearance of animal life, as shewn by the presence of a few genera of crustaceans, mollusks, and zoophytes, occupying layers of similar date in the crust of the earth. Proceeding upwards from the protozoic zone, wherein organic remains are comparatively rare, we then ascend to other sediments, in which, throughout nearly all latitudes, we recognise a copious distribution of submarine creatures, resembling each other very nearly, though imbedded in rocks now separated by very wide seas, and often raised up to the summits of high mountains. Examining all the strata exposed to view, that were formed during the first long natural epoch of similar life, termed silurian, we find that the successive deposits were charged with a great variety of forms of the trilobite,* a peculiar crustacean; of the orthoceratite,† the earliest chambered shell; as well as with numerous exquisitely formed mollusks, crenoids,‡ and zoophytes: the genus graptolite, of the latter class, being exclusively found in these silurian rocks. In short, my contemporaries have assembled from those ancient, and now desicated marine sediments or repositories of primeval creatures, examples of every group of purely aquatic animals, save fishes. The multiplied researches of the past twenty years have failed to detect the trace of a fish, amid the multitude of all other marine beings, in the various sediments which constitute the chief mass of the silurian rocks. Of these, though they are the

* Three lobed. † Ορθος, straight; Κερας, a horn. ‡ Κρινον, a lily; Ειδος, like.

lowest in the scale of the great division *vertebrata*, we are unable to perceive a vestige until we reach the highest zone of the upper silurian, and are about to enter on the Devonian period. Even on that horizon, the minute fossil fishes, long ago noticed by myself, are exceedingly scarce; and none have since been found in strata of higher antiquity. In fact, the few fragments of cartilagenous ichthyolites of the highest band of silurian rock, still retain the most ancient known being of their class. Looking, therefore, at the silurian system as a whole, and judging from the collection of facts gathered from all quarters of the globe, we know that its chief deposits (certainly all the lower and most extensive) *were formed* during a long period, in which, while the sea abounded with countless invertebrate animals, no marine vertebrate *had been called into existence.* The silurian (except at its close) was, therefore, a series in which there appeared no example of that bony framework of completed vertebræ, from which, as approaching to the vertebrate archetype, the comparative anatomist traces the rise of creative power, up to the formation of man. Whether, therefore, the term 'progressive,' or that of 'successive,' be applied to such acts of creation, my object is to shew, upon clear and general evidence, that there was a long period in the history of the world, wherein no vertebrate animal lived. In this sense, the appearance of the first recognisable fossil fishes is as decisive *a proof of a new and distinct creation, as that* of the placing of man upon the terrestrial surface, at the end of the long series of animals which characterise the younger geological periods." Prof. Owen, whose name is first among the greatest naturalists of the age, declares, "That a retrospect of the varied forms and proportions of the skeletons of animals, whether modified for aquatic, ærial, or terrestrial life, will shew that, whilst they were perfectly and beautifully adapted to the sphere of life, and exigencies of the species, they adhered with remarkable constancy to that general pattern or archetype which was first manifested on this planet, as geology teaches, in the class of fishes, and which has not been departed from even in the most extremely modified skeleton of the last and highest form which Creative Wisdom has been pleased to place upon the earth. It is no mere transcendental dream, but true knowledge and legitimate fruit of inductive research—that clear insight into the essential nature of each element of the bony framework, which is acquired by tracing them step by step, as *e. g.*, from the unbranched pectoral ray of the lepidosiren, to the equally small and slender, but bifid pectoral ray of amphiume; thence to the similar, but trifid ray of proteus; and through the progressively superadded structures and perfections of the limbs of the higher reptiles and mammals." In his very latest work (A. D. 1857) Hugh Miller adduces most elaborate testimony in support of the doctrine as above laid down: "Let us," he says, "in grappling with the vast multiplicity of our subject, attempt reducing and simplifying it by means of the classifying principle; not simply, however—again recurring to the remark of the metaphysician—as an internal principle given up by nature, but as an external principle, *exemplified* by nature. Let us take the organisms of the old geological periods in the order in which they occur in time; secure, as has been shewn, that if our chronology be correct, our classification will, as a consequence, be good. It will be for the Natural Theologians of the coming age to shew the bearing of this wonderful fact on the progress of man towards the just and the solid, and on the being and character of man's Creator—to establish on the one hand, against the undue depreciation of intellect and its results, that in certain departments of mind, such as that which deals with the arrangement and developement of the scheme of organic being, human thought is not profitlessly revolving in an idle circle, but progressing Godwards, and gradually unlocking the order of creation. And, on the other hand, he may demand of the Pantheist how—seeing that only such *persons* as the Cuviers and Lindleys, could have wrought out for themselves the real arrangement of this scheme—how, I say, or on what principle is it to be held, that it was a scheme originated and established at the beginning, not by *a personal*, but by an *impersonal* God. But our business is with the fact of parallel arrangements—divine and human—not with the inferences deducible from it.

"Beginning with the plants, let us, however, observe that they do not precede, in the order of their appearance, the humblest animals. No more ancient organism than the *oldhamia* of the lowest Irish silurians, a plant-like zoophyte, somewhat resembling our modern sertularia, has yet been detected by the geologist; though, only a few months ago, the researches of Mr. Salter, in the ancient rocks of Longmynd, Shropshire, previously deemed unfossiliferous, have given to it what seem to be contemporary vegetable organisms, in a few ill-preserved fucoids. So far as is yet known, plants and animals appear together. The long upward march of the animal kingdom takes its departure, at its starting point, from a thick forest of algæ. In Bohemia, in Norway, in Sweden, in the British Islands, in North America, wherever, in fine, what appears to be the lowest, or at least one of the lowest, zones of life has yet been detected, the rocks are found to be darkened by the remains of algæ, so abundantly developed in some cases, that they compose, as in the ancient lower silurian of Dumfrieshire, impure beds of anthracite, several feet in thickness, [and as is most probably the case in parts of Canada.] Apparently, from the original looseness of their texture, the individual plants are but indifferently preserved; nor can we expect that organisms so ancient should exhibit any very close resemblance to the plants which darken the half-tide rocks and skerries of our coasts at the present time. In the upper beds of the silurian, lycopodites are the only terrestrial plants yet found. In the lower old red sandstone we find, *added to these*, with thallogens, that bear at least the same general character as in the system beneath, minute ferns, and a greatly larger plant, allied to the horse tails. The old-red flora seems to have been an acrogenic flora. Ere passing to the luxuriant carboniferous flora, I shall make but one remark. *The existing plants, whence we derive our analogies in dealing with the vegetation of this early period, contribute but little, if at all, to the support of animal life.* The ferns and their allies remain untouched by the grazing animals. Even the insects that infest the herbacea of the botanist, almost never injure his ferns. Judging from all we yet know, the earliest terrestrial flora may have covered the dry land with its mantle of cheerful green, and served its general purposes, chemical and otherwise, in the well balanced economy of nature; but the herb-eating animals would have fared but ill, even where it throve most luxuriantly; and it seems to harmonise with the fact of its non-edible character, that up to the present time we know not that a single herbivorous animal lived among its shades. The flora of the coal measures was the richest and most luxuriant in at least individual productions, with which the botanist has formed any acquaintance. *Never before*, or *since*, did our planet bear so rank a vegetation. Almost all our coal—the stored up fuel of a world—forms but a comparatively small part of the produce of this wonderful flora; and, as Sir R. Murchison remarks, "the great carboniferous period is marked by the first copious and universally abundant terrestrial flora, *the prelude of which had appeared in the foregoing Devonian epoch.* This luxuriant tree vegetation is also especially remarkable for its spread over many latitudes and longitudes; and, together with it, occurs the same *common species* of marine shells, all indicating a more or less equable climate, from polar to inter-tropical regions; *a phenomenon wholly at variance with the present distribution of animal life on the surface of the globe.*" In the oolite flora, we find a few peculiar features introduced. The cycadeæ, a family of plants allied to the ferns on the one hand, and to the conifers on the other, and which, in their general aspect, not a little resemble stunted palms, *appear for the first time.* Its coniferous genera *receive* great accessions to their numbers, *and begin to resemble*, more closely than at an earlier period, the genera which still continue to exist: a further step towards the unfolding of the great system or plan of creation. The cypresses, the yews, the thujas, the dammaras, all make their earliest appearance in the flora of the oolite. Among our existing woods there seem to be but two conifers (that attain to the dignity of trees) indigenous to Britain, the common yew, *taxus baccata*, and the common Scotch fir, *P. sylvestris;* and yet we know that the latter alone formed, during the last few centuries, great woods, that darkened, for many miles together, the now barren moors and bare hill-sides of the highlands of Scotland. In the times of the oolite, on the other hand, Britain had from fourteen to twenty different species of conifers; and its great forests, of whose existence we have direct evidence in the very abundant lignites of the system, must have possessed a richness and variety which our ancient fir-woods, of the historic or human period, could not have possessed. With the conifers and cycadeæ there were many ferns associated, so many, that they still composed nearly two-fifths of the entire flora; and associated with these, *though in reduced proportions*, we find the fern allies. The reduction in these last is rather in species than in individuals. The broca coal, one of the most considerable oolite seams in Europe, seems to have been formed almost exclusively of an equisetum—E. columnare. In this flora, the more equivocal production of the coal measures are represented by what seems to be the last of the calamites; but it contains no lepidodendra, no ulodendra, no segellaria, no favularia, no knoria or halonia. Those monsters of the vegetable world, that united to the forms of its humbler productions the bulk of trees, had, with the solitary exception of the calamites, *passed into extinction;* and ere the close of the system, they, too, had disappeared. The forms borne by most of the oolite plants, were comparatively familiar forms. With the acrogens and gymnogens, we find the *first indication* of the liliaceæ or lily-like plants; of plants, too, allied to pandanaceæ or screw-pines, the fruits of which are sometimes preserved in a wonderfully perfect state of keeping in the inferior oolite; together with carpolithes—palm-like fruits, very ornately sculptured—and the remains of at least one other mono-cotyledon, that bears the somewhat general name of an endogenite. No true fossil palms have yet been detected in the great oolite and Wealden systems, though they certainly occur in the carboniferous and permean rocks, and are comparatively common in the earlier and middle tertiary formations. Much cannot be founded on merely negative evidence; but it would be certainly a curious circumstance, should it be found that this graceful family, first ushered into being some time in the later palæozoic periods, was *withdrawn from creation** during the middle ages of the earth's history, *to be again introduced* in greatly more than earlier proportions, during the tertiary and recent periods.

* We shall see that this remark is true of other creations.

The earlier flora of the tertiary division presents an aspect widely different from that of any of the previous ones. The ferns and their allies *sink into their existing proportions;* nor do the coniferæ, previously so abundant, occupy any longer a prominent place. On the other hand, the dicotyledinous herbs and trees, *previously* so *inconspicuous* in creation, are largely developed. Trees of those amentiferous orders, to which the oak, the hazel, the beech, and the plane belong, were, perhaps, not less abundant in the eocene woods, than in those of the present time; they were mingled with trees of the laurel, the leguminous, and the anonaceous or custard apple families, with many others; and deep forests in the latitude of London (in which the inter-tropical forms must now be protected as in the Crystal Palace, with coverings of glass and warmed by artificial heat) abounded in graceful palms. The nearer we approach to existing times, the more familiar in form and outline do the herbs and trees become.* We detect, at least, one existing *order* in the ferns of the coal measures; we detect, at least, existing *genera* among the coniferæ, equisetaceæ, and cycadaceæ of the oolite; the acacias, gourds and laurels of the eocene flora, and the planes, willows and buckthorns of the miocene, *though we fail to identify their species with aught that now lives*, still more strongly remind us of the recent productions of our forests

* And the same is true of the animal kingdom.

and conservatories; and on entering on our downward course, the pleistocene period, we at length find ourselves among familiar species. We at least know, generally, that with each succeeding period there appeared a more extensively useful and various vegetation than that which had gone before. In referring to the sombre unproductive character of the earliest terrestrial flora with which we are acquainted, we remark that it was a flora unfitted, apparently, either for graminiferous bird, or herbiverous quadruped. The singularly profuse vegetation of the coal measures, was, with all its wild luxuriance, of a resembling cast. So far as appears, neither flock nor herd could have lived on its richest or greenest plains; nor does even the flora of the oolite seem to have been in the least suited for the purposes of the shepherd or herdsman. Not until we enter on the tertiary periods, do we find floras amid which *man* might have profitably laboured as a dresser of gardens, a tiller of fields, or a keeper of flocks and herds. Nay, there are whole orders and families of plants, of the *first importance to man, which do not appear* until late even in the tertiary ages. Some degree of doubt must always attach to merely negative evidence, but Agassiz finds reason to conclude that the order rosaceæ—an order more important to the gardener than almost any other, and to which the apple, the pear, the quince, the cherry, the plum, the peach, the apricot, the nectarine, the almond, the raspberry, the strawberry, and the various bramble berries belong, together with all the roses and the potentillas—was introduced only a short time previous to the appearance of man. And the true grasses—a still more important order—which, as the corn-bearing plants of the agriculturist, feed at the present time at least two-thirds of the human species, and, in their humble varieties, form the staple food of the *grazing* animals, *scarce appear in the fossil state at all.* It is certainly no mere coincidence, this correspondence between geology and Scripture; food fit for man and his associate sub-kingdom of animals, is discovered to be the order of creation by the geologist. They are peculiarly plants of the human period. Yet, with all this amount of evidence, it is dogmatically declared that the Mosaic history is false; but if an intelligent power was adequate to the task of guiding the plan of creation, why deny the validity of a history which accumulated evidence stamps with truth?

With regard to the animal kingdom, the same law of adaptation and progression holds good. The fauna of the silurian system bears, in all its three great types, the stamp of a fashion peculiarly antique, and which, save in a few of the mollusca, has long since become obsolete. Its radiate animals are chiefly corals, simple or compound, whose inhabitants may have somewhat resembled the sea-anemones, with zoophytes akin mayhap to the sea-pens, though the relationship must have been a remote one ; and the numerous crinoids or stone-lilies, some of which consisted of but a sculptured calyx, without petals, while others threw off a series of long flexible arms, that divided and subdivided like the branches of a tree, and were thickly fringed by hair-like fibres. The difference between the older and newer formations or fashions, as exemplified in the cup-shaped corals, may be indicated in a single sentence. The ancient corals were stars of four rays, or of multiples of four: the modern corals are stars of six rays, or multiples of six. *But though at a certain definite period*—that during which the great palæozoic division ended, and the secondary division began—*nature, in forming* this class of creatures, discarded the number four, and adopted, instead, the number six; the great leading idea of the star itself was equally retained in corals of the modern, as in those of more ancient type. The articulate of the silurian periods bore a still *more peculiar* character. They consisted only of trilobites, which, after receiving so immense a developement during the *middle* and later times of the silurian period, that whole rocks were almost formed exclusively of their remains, gradually died out in the times of the old-red sandstone, and *disappeared for ever* from creation after the carboniferous limestone had been deposited. The palæontologist knows no more unique family than that of the trilobites, or a family more unlike any which now exists, or a family which marks with more certainty the early rocks in which they occur. And yet, though formed in a fashion that perished myriads of ages ago, how admirably does it not exhibit the articulated type of being, and illustrate that unity of design which, amid endless diversity, pervades all nature. In its general character, the silurian fauna, antiquely fashioned as became its place in the primeval ages of existence, was unlike any other which the world ever saw; and the absence of the vertebrata, or at least the inconspicuous place which they occupied, if they were present at all, must have imparted to the whole, as a group, a humble and mediocre character. It seems to have been for many ages together a creation of molluscs, corals, and crustacea. At length, in an upper bed of the system, immediately under the base of the old-red sandstone, the remains of the earliest known fishes appear, blended with what also appears, for the first time, the fragmentary remains of a terrestrial vegetation. The rocks beneath this ancient bone-bed have yielded no trace of any plants higher than the thallogens, or at least not higher than zosteraceæ—plants whose proper habitation is the sea; but through an apparently simultaneous advance of the two last kingdoms, animal and vegetable, the first land plants and the first vertebrates appear together in the same deposits. We may here adduce a very remarkable instance of the correspondence which obtains between the sequence in which certain classes of being were first ushered into existence, and the order of classification adopted, after many revisions, by the higher naturalists. Cuvier, with not a few of the icthyologists which preceded him, arranged the fishes into two distinct series, the cartilaginous and osseous; and these last he mainly divided into the hard, or spiny-finned fishes, and the soft, or joint-finned fishes. *The place assigned to the class of fishes as a whole, corresponded to their place in the palæontological scale; first, of the vertebrate division, in the order of their appearance they border, as in the "*animal kingdom*" of the naturalist, on the invertebrate divisions. It was not until the new classification of Agassiz had ranged them after a different fashion, that the correspondence became complete in all its parts.

The horizontal lines represent the divisions of the great geologic system, while the vertical lines indicate the sweep of the several orders of fishes across the scale, and the periods, so far as has yet been determined, of their first occurrence in creation.

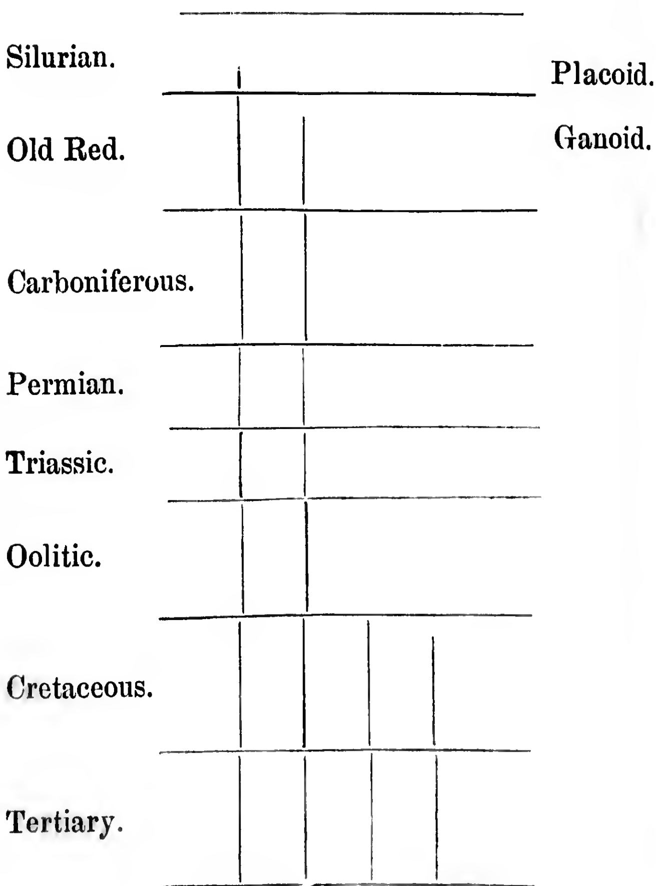
The oldest known reptiles appear a little before the close of the old red sandstone, just as the oldest fishes appeared a little before the close of the silurian system. What seems to be the upper old-red of our own country, though there still hangs some shade of doubt on the subject, has furnished

* See diagram, next page.

DIAGRAM.

ARRANGEMENT:

Geological.—Placoid. Ganoid. Ctenoid. Cycloid.
Agassiz. —Placoid. Ganoid. Ctenoid. Cycloid.



the remains of a small reptile, equally akin, it would appear, to the lizards and the batrachians ; and what seems to be the upper old-red of the United States, has exhibited the foot-tracks of a larger animal of the same class, which not a little resemble those which would be impressed on recent sand or clay by the alligator of the Mississippi, did not that animal efface its own foot-prints (a consequence of the shortness of its legs) by the trail of its abdomen. In the coal measures, the reptiles hitherto found are all allied, though not without a cross of the higher crocodilian or lacertian* nature, to the batrachian order—that lowest order of reptiles to which the frogs, newts and salamanders belong. It was not until the permian and triassic systems had come to a close, and even the earlier ages of the oolitic system had passed away, that the class received its fullest developement in creation. And certainly very wonderful was the developement which it did then receive. Reptiles became every where the lords and masters of this lower world. When any class of the *air-breathing* vertebrates is very largely developed, we find it taking possession of all the three old terrestrial elements, air, earth, and water. The human period, for instance, like that which immediately preceded it, is peculiarly a period of mammals ; and we find the class *free*, if I may so express myself, of the three elements, disputing

* Lizard.

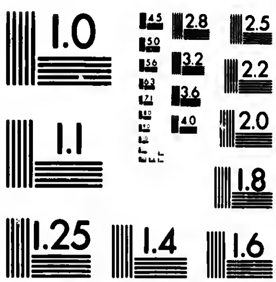
possession of the sea with the fishes, in its cetaceans,* its seals, and its sea-lions; and of the air, with its birds, in its numerous genera of the bat family. Further, not until the great mammaliferous period is fairly ushered in, do either the bats or the whales make their appearance in creation. Remains of oolitic reptiles have been mistaken in more than one instance for those of cetacean; but it is now generally held that the earliest known specimens of the family belong to the tertiary ages, while those of the oldest bats occur in the eocene of the Paris basin, associated with the bones of dolphins, lamantines, and morses. Birds make their first appearance in a red sandstone deposit of the United States, at least not older than the times of the lias. No fragments of the skeletons have yet been discovered in formations older than the chalk. The Connecticut remains are those of foot-prints exclusively; and yet they tell their extraordinary story, so far as it extends, with precision and distinctness. With the Stonefield slates—a deposit which lies above what is known as the inferior oolite—the remains of the mammiferous animals first appear. As, however, no other mammalian remains occur until after the close of the great secondary division, and as certain marked peculiarities attach to the oolitic ones, it may be well to enquire whether their place, so far in advance of their fellows, may not be indicative of

* *Cete*, a whale.

a radical difference of character—a difference considerable enough to suggest to the zoologist an improvement in his scheme of classification. It has been shewn by Prof. Owen, that while one Stonefield genus unequivocally belonged to the marsupial* order, another of its genera bears also certain of the marsupial traits; and that the [illegible] which they composed—a very small one, [illegible]sisting exclusively of minute insect-eating [illegible]—exhibits, in its general aspect, the characteristics of the pouched family. The placental mammals make their appearance in the earliest ages of the great tertiary division, and exhibit in the group an aspect very unlike that which they at present bear. The eocene ages were peculiarly the ages of the palæotheres†—strange animals of that pachydermatose or thick-skinned order, to which the elephants, the tapirs, the hogs and the horses belong. It had been remarked by naturalists, that there are fewer families of this order in living nature, than of almost any other; and that, of the existing genera, not a few are *widely separated*, in their analogies, from the others. But in the palæotheres of the eocene, which ranged in size from a large horse to a hare, *not a few* of the *missing* links have been found—links connecting the tapirs to the hogs, and the hogs to the palæotheres proper; and there is at least one species *suggestive of an union* of some of the more peculiar traits of

* *Marsupium*, a purse. † *παλς*, ancient; *θηριον*, beast.

IMAGE EVALUATION
TEST TARGET (MT-3)



the *tapirs* and the *horses*. In the middle or miocene tertiary, pachyderms, though of a wholly *different type from their* predecessors, are still the prevailing forms. The dinotherium,* one of the greatest quadrapedal mammals that ever lived, seems to have formed a *connecting* link between the pachydermata† and the cetacea. The group of mammals which, in Europe at least, immediately preceded the human period, seems to have been every where a remarkable one; and nowhere was it more so than in the British Isles. The present mammilaferous fauna is rather poor, but the contents of the later deposits shew, that we must regard it as being fragmentary of a very noble one, associated with species that still exist in the less cultivated parts of the country, such as the badger, the fox, wild cat, roe, and red deer; we also find the remains of great animals, whose congeners must now be sought for in the inter-tropical regions.

Sir C. Lyell observes that "Each local change in climate and physical geography is attended with the immediate increase of certain species, and the limitation of the range of others. A revolution thus effected is rarely, if ever, confined to a limited space, or to one geographical province of animals or plants, but affects several other surrounning or contiguous provinces. In each of these, moreover, analogous alterations of the stations and habitations of species

* Δεινος, terrible; θηριον, beast. † παχυς, thick; δηρμα, skin.

are simultaneously in progress, reacting in the manner already alluded to on the first province. Hence, long before the geography of any particular district can be essentially altered, the flora and fauna throughout the world will have been materially modified by countless disturbances in the mutual relation of the various members of the organic creation to each other. To assume that in one large area, inhabited exclusively by a single assemblage of species, any important revolution in physical geography can be brought about, while other areas remain stationary in regard to the position of land and sea, the height of mountains, and so forth, is a most improbable hypothesis, wholly opposed to what we know of the laws now governing the aqueous and igneous causes. On the other hand, even were this conceivable, the communication of heat and cold between different parts of the atmosphere and ocean is so free and rapid, that the temperature of certain zones cannot be materially raised or lowered without others being immediately affected; and the elevation or diminution in height of an important chain of mountains, or the submergence of a wide tract of land, would modify the climate even of the antipodes." And, as a consequence of this, it is most improbable that animals and plants should have lived through any very material changes of the earth's surface.

Again, that Creative Intelligence has interfered, or rather continually guided the progress of creation, we gather from the fact that, "As the ancient fishes have left their remains in the rocks of all epochs, they afford a satisfactory demonstration of the law which limits fossil forms to different stages of the earth's history. Of the one thousand fossil species at present known, not one is identical with any species now living, and none of the fossil species pass from one stage to another. The history of fossil fishes affords an unanswerable argument against the hypothesis, that a gradual developement in the species of animals has taken place during past ages: an idea now known as the developement theory. We find the fossil fishes belonging to the placoid and ganoid orders, which are in fact the most highly organised types of the class, approached reptiles in some important points of their anatomy; that these highest orders maintained their dominion during the deposition of the palæozc triassic, and oolitic strata,* and preserved their typical structure through all the changing conditions to which they were exposed. The cycloid and ctenoid orders *were not created* until towards the close of the cretaceous period—their organisation being inferior to the placoids and ganoids, they could only have appeared by a *special act* of creation, as it would be fatal to the hypothesis of developement to admit that higher organisms could become the progenitors of lower

* See map of succession of strata.

forms. In fine, the history of fossil fishes supplies abundant evidence in support of the opinion that the Almighty has, from time to time, created those forms of life *which were best adapted to the changing condition of the earth's surface.* Hence we see families and genera appearing in numbers, destined to live for a limited time, and to become extinct with the close of the stage which they characterise. We therefore conceive that the deductions of Mr. Miller are not consistent with the general laws which govern the life of animals, and are utterly irreconcilable with the facts of natural history. From the very remark above quoted, we must conclude that the continuous life from one period to another, as assumed by some geologists, is in direct opposition to the laws which they themselves admit to govern the distribution and preservation of life, and proves that the supposed law of uniformity of Sir C. Lyell is not by any means established, and does not harmonise with the plan of creation, which consists in a series of interventions and adaptations, which comprehend not only the good of a single family, but the continous advancement and fulfilment of a general plan of creation, having for its end the constitution of an order of beings capable of understanding and working out this scheme of creative wonder, and of offering adoration for gifts which lift them from their association with earthly co-temporaries, to a goodly company of spirits, in whom alone are displayed, in comparative perfection, moral and spiritual excellencies.

It is manifest that there has been a constant bringing forward of some special parts of the plan, and that the inferences which are drawn from the resemblance which the plants and animals of Australia and of America have to former epochs, are not correct, and cannot be taken as illustrative of lineal descent. Mr. B. Jukes remarks on this, that "The animals and plants of Australia are very peculiar, and many of them such as are found nowhere else living in the world. Now some of the marine shells, and some of the land animals and plants, more resemble those found fossil in rocks deposited during the early geological period—the oolitic in Britain—than they do any other ordinal or generic types. We must guard against the idea of their being *in any way the direct descendants*, though they may be considered the representatives of oolitic species. Why the oolitic types should have been preserved in Australia, and *new species introduced there fashioned on those types*, while in other parts of the world new types were used, is a mystery we are yet unable to fathom." Agassiz has made a similar announcement as to the fauna and flora of America; here, then, we have two vast areas of re-introduction of typical forms, and we imagine that a simple answer may be given to Mr. Jukes' query, by referring to the great fact that the plan of creation was not a completed plan, but was one gradually unfolded, and brought forward to completion; so that we should expect to find a bringing on of the parts, and a revelation or perfecting of those which were required to complete the structure. In like manner we must infer, that the interference with the plan would be regulated by the general interests, and ultimate good of the whole.

Agassiz admits that "the total absence of the highest representatives of the animal kingdom in the oldest deposits forming part of the crust of our globe, has actually led to the very general belief, that the animals which have existed during the earliest period of the earth, were inferior to those now living; nay, that there is a natural gradation from the oldest and lowest animals, to the highest now in existence. *To some extent this is true;* but it is certainly not true, that all animals form one simple series from earliest times, during which only the lowest types of animals would have been represented, to the last period, when man appeared at the head of the animal kingdom. It is not in the successive appearance of the great branches of the animal kingdom, that we may expect to trace a parallelism between their succession in geological times, and their relative standing at present. Nor can any such correspondence be observed between the appearance of the classes, at least not among radiate, and mollusca, and articulata, as their respective classes seem to have been introduced simultaneously on the earth, with, perhaps, the sole exception of the insects, which are not known to have existed before the carboniferous period. Among the vertebrata, however, there appears already a certain coincidence even within the limits of the classes, between the time of their introduction, and the rank their representatives hold, in comparison one to another. It is only within the limits of the different orders of each class, that the parallelism between the succession of the representatives in past ages, and their respective rank in the present period, is decidedly characteristic. But if this is true, it must be at the same time obvious to what extent the recognition of this correspondence may be influenced by the state of our knowledge of the true affinities and natural gradations of living animals.

"I shall therefore limit myself," says Agassiz, "to a general comparison, which may be sufficient to shew that the improvements which have been introduced into our systems, upon purely zoological grounds, have nevertheless tended to render more apparent the coincidence between the relative standing among living animals, and the order of succession of their representatives in past ages. I have lately attempted to shew that the order of halcyonoids, among polypes, is superior to that of actinoids; that in this class compound communities constitute a higher degree of developement, when contrasted with the characters and mode of existence of the single polypes, as exhibited by the actinia ;* that top-budding is superior to lateral budding ; and that the type of madrepores, with their top-animal, or, at least, with a definite and limited number of tentacles, is superior to all other actinoids. If this be so, the prevalence of actinoids in older formations, to the exclusion of halcyonoids ; the prevalence of *rugosa* and *tabulata*, in the oldest deposits ; the later prevalence of asteroids, and the very late introduction of madrepores, would already exhibit a correspondence between the rank of living polypes, and the representatives of that class in past ages, though we may hardly expect a very close coincidence in this respect between animals, the structure of which is so simple.

The gradation among the orders of echinoderms is perfectly plain. Lowest stand the crinoids, next the asteroids,† next the echinoids,‡ and highest the holothuroids.§ Ever since this class has been circumscribed within its natural limits, this succession has been considered as expressing their relative natural standing ; and modern investigation, respecting their anatomy and embryology, however extensive, have not led to any important change in their classification, as far as the estimation of their rank is concerned. This is also precisely the order in which the representatives of this class have been

* *αχτιν*, a ray. † *αστρον*, a star. ‡ *εχινος*, a hedgehog. § Soft sea-slugs.

successively introduced upon earth in past geological ages. Among the oldest formations, we find pedunculated crinoids only, and this order remains prominent for a long period of successive periods; next come free crinoids and asteroids; next echinoids, the successive appearance of which, since the triassic period to the present day, coincides also with the gradation of their sub-divisions, as determined by their structure; and it was not until the present period, that the highest echinoderms, the holothuroids, have assumed a prominent position in their class.

Among acephala,* there is not any more uncertainty, respecting the relative rank of their living representatives, than among echinoderms. Every zoologist acknowledges the inferiority of the bryozoa† and brachciapods,‡ when compared with lamellibranchiata;§ and among these, the inferiority of the monomyaria, in comparison with the dimyaria, would hardly be denied. Now if any fact is well established in palæontology, it is the earlier appearance and prevalence of bryozoa and brachciopods in the oldest geological formations, and their extraordinary developement for a long succession of ages, until lamellibranchiata assume the ascendancy which they maintain to the fullest extent at present.

The order of succession of vertebrata in past ages exhibit features in many respects differing greatly

* *α*, without; Κεφαλή, a head.
† *Βρυον*, moss; *Ζωον*, animal.
‡ *Βραχιον*, an arm; *ποδες*, feet.
§ *Lamella*, a plate; *Βραγχια*, gills.

from articulata, mollusks, and radiata. Among these we find their respective classes appearing simultaneously in the oldest periods in the history of our earth. Not so *with the vertebrata*, for although fishes may be as old as any of the lower classes, reptiles, birds, and mammalia are introduced successively in the order of their relative rank in their type. Again, the earliest representatives of their classes do not always seem to be the lowest; on the contrary they are, to a certain extent, and in a certain sense the highest, in as far *as they embody characters which, in later periods, appear* separately in higher classes, to the exclusion of what henceforth constitutes the special character of the lower class. For instance, the oldest fishes known partake of the characters which, at a later time, are exclusively found in reptiles, and no longer belong to the fishes of the present day. It may be said that the oldest fishes are rather the oldest representatives of the type of vertebrata, than of the class of fishes, and that this class assume only its proper characters after the introduction of the class of reptiles upon earth. It is plain that, before the class of reptiles was introduced upon our globe, the fishes being then the only representatives of the type of vertebrata, were invested with the characters of a higher order, embodying, as it were, a prospective view of a higher developement in another class, which was introduced as a distinct type only at a later period; and from that time the reptilian character, which had been so prominent in the oldest fishes, was gradually reduced, till in more recent periods, and *in the present creation*, the fishes lost all this herpetological relationship, and were at last endowed with characters, which contrast as much, when compared with those of reptiles, as they agreed closely at the beginning. Lepidosteous alone reminds us, in our time, of these old fashioned characters of the class of fishes, as it was in former days. Similar relations may be traced between the reptiles and the classes of birds and mammalia which they precede. We need only allude to the resemblance of the pterodactyle and the birds, and to that of icthyosauri and certain cetacea. Yet through all these intricate relations, there runs an evident tendency towards the production of higher and higher types, until at last man crowns the series. Seen, as it were, at a distance, so that the mind can take a general survey of the whole, and perceive the connexion of the successive steps, without being bewildered by the details, such a series appears like the developement of a great conception, expressed in such harmonious proportions, that every link appears necessary to the full comprehension of its meaning, and yet so independent and perfect in itself, that it might be mistaken for a complete whole; and again so intimately connected with the preceding and following members of the series, that one might be viewed as flowing out of the other.

What is universally admired as characteristic of the highest conception of genius, is here displayed in a fulness, a richness, a magnificence, an amplitude, a perfection of details, a complication of relations, which baffle our skill and our most persevering efforts to appreciate all its beauties. Who can look upon such series, coinciding to such an extent, and not read in them the successive manifestations of a thought, expressed at different times, in ever *new* forms, and yet tending to the same end, onwards to the coming of man, whose advent is already prophesied in the first appearance of the earliest fishes."

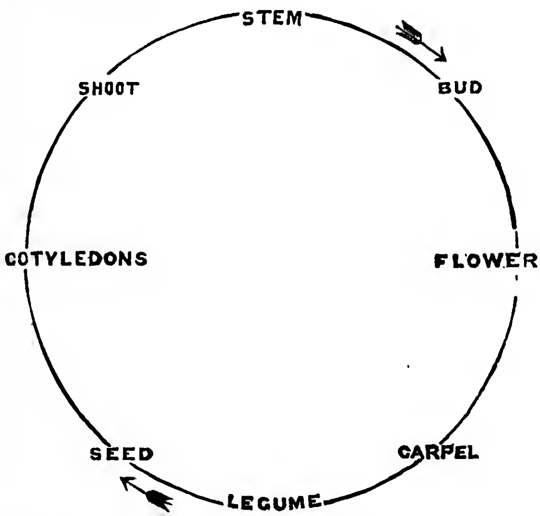
In taking a careful survey of the facts which the geologist has industriously collected, and weighing the evidence which he brings forward to support his constantly repeated declaration of adjustments in creation, the unprejudiced mind must admit that no fortuitous concurrence of atoms, no blind incomprehensible concatenation of circumstances, could have so repeatedly resulted in the production of events which, for grandeur and marvellous wisdom, surpass the most daring flights of human imagination. We are forced to admit that, where man's voice is feeble, "the rocks cry out," and bear testimony to a power unseen, but not unknown—invisible, but yet revealed in majesty, and awful even in concealment. The most daring doubter will not deny that the records of the past testify plainly to an orderly system of events, and unfold to man the deep foundations of a scheme which was laid "in the beginning." Nay! so evident is it that *the plan* of creation has been one of progression, that it was even surmised—till research upset the dream—that all things were mutually convertible, and the world but a system of developement. Geologists and naturalists unanimously accord their testimony to such truths as are alone consistent with reason and common sense, and fully prove the creations past to have been controlled by an intelligent, designing mind. "Passing," says Sir R. Murchison, "rapidly over the earliest stages of the planet, which are necessarily involved in obscurity, our sketch of nature began with the first attainable evidences of the formation of sediments composed of mud, sand, and pebbles. It was shewn that the lowest accessible of these deposits, though of enormous dimensions, and occasionally less altered than strata formed after them, are almost entirely azoic, or void of traces of inhabitants of the seas in which they were accumulated. One solitary genus of zoophytes has been alone detected in such bottom rocks; the heat of the surface having been, it is supposed, adverse to life. In the next formations, scarcely differing at all in mineral character from those which preceded them, observers in various regions have detected clear and unmistakeable signs of a contemporaneous appearance of animal life, as shewn by the presence of a few genera of crustaceans, mollusks, and zoophytes, occupying layers of similar date in the crust of the earth. Proceeding upwards from the protozoic zone, wherein organic remains are comparatively rare, we then ascend to other sediments, in which, throughout all latitudes, we recognise a copious distribution of sub-marine creatures, resembling each other very nearly, though imbedded in rocks now separated by wide seas, and often raised up to the summits of high mountains. Examining all the strata exposed to view, that were formed during the first long natural epoch of similar life, termed silurian, we find that the successive deposits are charged with a great variety of forms—of the trilobite, a peculiar crustacean; of the orthoceratite, the earliest chambered shell, as well as with exquisitely formed mollusks, crinoids, and zoophytes; the genus graptolite, of the latter class, being exclusively found in the silurian rocks. In short, from those ancient and now desicated marine sediments or repositories of primeval creatures, examples of every group of purely aquatic animals, save fishes, are assembled. The multiplied researches of the last twenty years have failed to detect the trace of a fish, amid the multitudes of all other marine beings in the various sediments which constitute the chief mass of the silurian rocks. Of these, though they are the lowest in the scale of the great division *vertebrata*, we are unable to perceive a vestige until we reach the highest zone of the upper silurian, and are about to enter upon the Devonian period. Even on that horizon, the minute fossil fishes long ago noticed by myself, are exceedingly scarce, and none have since been found in strata of higher antiquity. In fact, the few fragments of cartilaginous ichthyolites of the highest band of silurian rocks, still remain the most ancient known beings of their class.

"Looking, therefore, at the silurian system as a whole, and judging from the collection of facts gathered from all quarters of the globe, we know that its chief deposits (certainly all the lower and most extensive) were formed during a long period, in which, while the sea abounded with countless invertebrate animals, no marine *vertebrata had been called into existence.* The silurian, except at its close, was therefore a series in which there appeared no example of that long framework of completed vertebræ, from which, as approaching to the vertebrate archetype, the comparative anatomist traces the rise of creative power up to the formation of man."

Whether, therefore, the term of "progressive," or "successive," be applied to such acts of creation, the object is simply to shew, upon clear and general evidence, that there was a long period in the history of the world, wherein no vertebrated animal lived. In this sense, the appearance of the first recognisable fossil fishes is as decisive a proof of a new and distinct creation, as that of the placing of man upon the terrestrial surface, at the end of the long series of animals which characterise the younger geological periods.

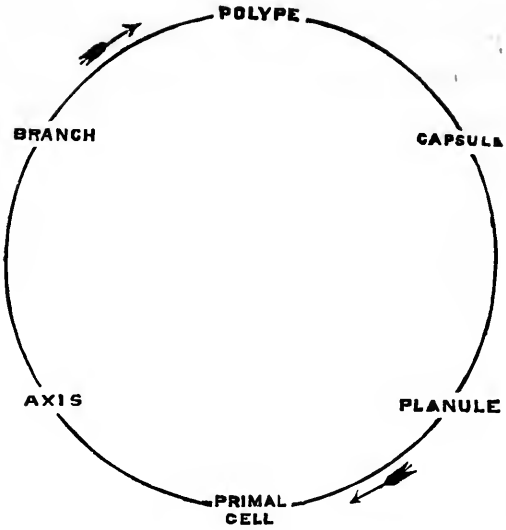
Nor have we been able to disinter from the older strata of this long period of invertebrate life, any distinct fragments of land plants. But just in the same stratum wherein the few earliest small fishes have been detected, there also have we observed the first appearances of a diminutive, yet highly organised, tree vegetation. If it be granted that the position of the earliest recognisable vertebrata is good positive evidence on which to argue, still it might be contended that such forms may, at a future period, be found in lower strata. In this work we only reason on known data. Nor is it on this testimony alone, strong, clear, and universal as it is, that my view is sustained, for as soon as we pass into the formation immediately over-lying, and quit the zone wherein the first few small fishes are to be detected, we are furnished with collateral proofs that this was the earliest great step in a progressive order of creation. In the following or Devonian period, we are surrounded by a profusion of larger fossil fishes, with vertebræ, for the most part very imperfectly ossified, and with dermal skeletons of very singular forms ; all differing vastly from any thing of their class in existing nature. These fishes were thus clearly added to the other forms of marine life. Again, in this Devonian era, we are presented with well defined land plants, also of much larger dimensions than the very rare specimens in the uppermost silurian ; while, towards the close of the period, we meet with an air-breathing reptile. The little telerpeton had groves of tree ferns or lycopodaceous plants, and even of coniferæ, amid the roots of which he could nestle. Just as the introduction of cartilagenous fishes is barely traceable at the close of the long silurian era, so becoming soon afterwards more abundant, they are associated in all younger formations with true osseous fishes, whose remains are found intermixed with the other exuviæ of the sea. Putting aside, therefore, theory, and judging solely from positive observation, we may fairly infer, first, that during very long epochs, the seas were unoccupied by any kind of fishes; secondly, that the earliest discoverable creatures of this class had an internal framework, almost incapable of fossilisation, and left in the strata their teeth and dermal skeletons only; and, thirdly, that in the succeeding periods, the oldest fishes having bony vertebræ make their scanty appearance, but become numerous in the overlying deposits.

Are not these absolute data of the geologist clear signs of a progress in creation? We may further strengthen these declarations, by accepting the illustrative arguments of Mr. Gosse, although not agreeing with his views on the main question which he raises: "Creation," he remarks, "*is the sudden bursting into a circle*—the sovereign fiat of Almighty Power, the commencing point which we in vain seek in nature." Take the course of a plant, it is a circle without beginning, without end; that is, unless it commence as a created thing. At what point of its history can you put your finger and say, "Here is the commencement of this organism, before which there is a blank; here it began to exist?" There is no such point; no stage which does not look back to a previous stage, on which *this* stage is inevitable and absolutely dependent. This may be rendered more clear by a diagram:—



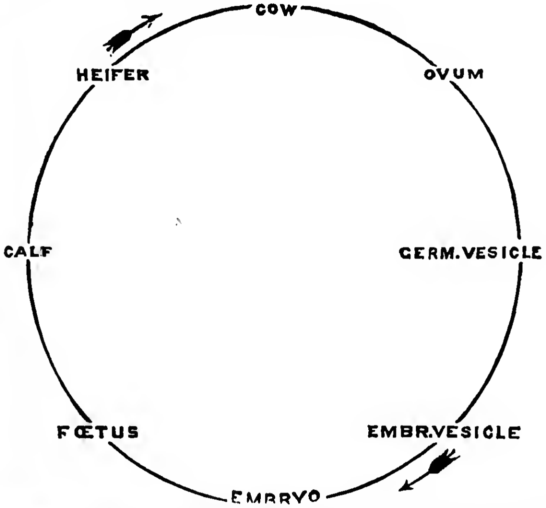
The *plumularia*, a shrub-like zoophyte, comprising within its populous branches some twenty thousand polypes, tells a similar story.

Every individual cell now inhabited by its tentacled hydra, has, in its turn, budded out from a branch, which was itself but a lateral process from the central axis. And this was but the prolongation of what was at first a single cell, shooting up from a



creeping root-thread. A little earlier than this, there was neither cell nor root-thread; but the organism existed in the form of a *planule*, a minute soft-bodied, pear-shaped worm, covered with cilia, that crawled softly over the stones and sea-weeds. Whence came it? A few hours before it had emerged from the mouth of a vase-like cell, one of the ovarian capsules which studded the stem of an old well-peopled plumularia shrub, and which had been gradually developed from its substance by a process analogous to budding. And then if we follow the history of this earlier shrub backward, it will only lead us through exactly the same correspondent stages—primal cell, planule, ovarian capsule, stem, and so on interminably. Once more: the cow was a year or two ago a heifer, with budding horns.

The year before she was a bleating calf, which again had been a breathless fœtus wrapped up in the womb of its mother. Earlier still it had been an unformed embryo; and yet earlier, an embryonic vesicle, a microscopically minute cell, formed out of one of the component cells of a still earlier structure —the germinal vesicle of a fecundated ovum. But this ovum, which is the remotest to which we can trace the history of our cow as an individual, was, before it assumed a distinct individuality, an undistinguishable constituent of a viscus—the ovary—of another cow, an essential part of her structure, a portion of the tissues of *her* body, to be traced back, therefore, through all the stages enumerated above, to the tissues of another parent cow, as long as we choose to follow it:—



This is the order of all organic nature. It is evident there is no one point in the history of any single creature, which is a legitimate *beginning of its existence.* And this is not a law of some particular species, but of all: it pervades all classes of animals, all classes of plants: the life of every organic being is whirling in a ceaseless circle, to which one knows not how to assign *any* commencement. The life-history of any organism commenced at some point or other of its circular course. It was created, called into being, in some definite stage. Possibly various creatures differed in this respect: perhaps some began existence in one stage of developement, some in another; but every separate organism had a distinct point at which it began to live. Before that point there was nothing; this particular organism had till then no existence,—*it was not.* The primary creature must have been suddenly created and constituted a perfect being: for the care and nurture of the young, there must be a mother—there must be a pair to originate the offspring.

Now what is true of the course of individual creations, is just as true of the order of creation and order of adaptation. From what we have already learned of the progress by sea, turn we to the land, and behold evidence as conclusive of the repeated adjustment of the plan of creation. We trace back the first appearance of plant or animal to a particular stage in the world's history; we find it there and only there, and, from the laws of life at this hour, are forced to conclude that the creature could only have been placed on the earth, at the given epoch, by some All-Powerful Creative Agent. Every geologist sets before us the same facts, and constantly presents to our incredulous minds the proofs of the advent of new beings on the stage of life. The sea has, as we have shewn, furnished witnesses; the land may now tell us its story, for there is progress in the productions of the land; the great carboniferous period being marked by the first copious and universally abundant terrestrial flora, the prelude to which had appeared in the foregoing Devonian epoch. This earliest luxuriant tree vegetation, the pabulum of our great coal-fields, is also especially remarkable for its spread over many latitudes and longitudes; and together with it occur *the same* common species of marine shells, all indicating a more or less equable climate—from polar to inter-tropical regions—a phenomenon wholly at variance *with the present distribution* of animal or vegetable life over the surface of the planet. While the permian era was distinguished by the disappearance of the greater number of primeval types, and *by the essential modification of those which remained*, it still bore a strong resemblance, through its plants and animals, to the carboniferous period; whilst, in unison with all the great facts elicited by our survey of the older strata, it was marked by the appearance of an animal of a higher grade than any one in the foregoing eras—a large thecodont reptile—allied, according to Mr. Owen, to the living monitor.

In speaking of the silurian, Devonian, carboniferous, and permian rocks, let us explain that, whilst each of the three latter groups occupy wide spaces in certain regions, no one of them is of equal value with the silurian, in *representing time*, or the succession of animal life on the globe. When the silurian was divided into lower and upper parts, our acquaintance with younger formations simply sufficed to shew a complete distinction between its animal remains as a whole, and those of the carboniferous rocks, from which it is separated by the thick accumulations of the old-red sandstone. At that period, the shelly, slaty rocks of Devonshire were not known to be the equivalents of the old-red; still less had the relations and fossil contents of the strata, now called permian, been ascertained. Judging from the fossils then collected, it was believed that the lower silurian contained organic remains very distinct from those of the upper; and yet the two groups were united in a system, because they were characterised throughout by a common *faciès*. This so-called system was, in short, typified by a profusion of trilobites and graptolites, with orthides and pentameri of a type *wholly unknown* in the carboniferous rocks. And whilst fishes were seen to exist in the intermediate masses of the old-red sandstone, no traces of them could be detected below the very uppermost zone of the silurian rocks. Nineteen years have elapsed, and after the most vigilant researches in various regions of both hemispheres, these great features remain the same as when first indicated. At the close of the permian era *an infinitely greater change took place in life*, than that which marked the ascent from the silurian system to the overlying groups. *The earlier races then disappeared*, (at least all the species,) and *were replaced by an entirely* NEW CREATION, the generic types of which were continued through those long epochs which geologists term secondary or mesozoic (the mediæval age of extinct beings). In these, again, we learn how one creation followed another, each characterised by *different* creatures; many of them, however, exhibiting, near their downward and upward limits, certain fossils which *link on one reign of life to another*. In connexion with these facts, we must carry in our minds the law of the dependence of life on external conditions; for in surveying the whole series of formations, the practical geologist is fully impressed with the conviction, that there has at all times subsisted a very intimate connexion between the existence, or, at all events, the preservation of animals, and the media in which they have been fossilised. The chief seat of former life in each epoch is often marked by a calcareous mass, mostly in a central point, towards which the animals increase from below, and whence they diminish upwards. Thus, Llandeilo limestone of the lower silurian, and the Wenlock of the upper, are respectively centres of animalisation of each of those groups. In like manner, the Eifel limestone is the true index of the Devonian, the mountain limestone of the carboniferous, and the Zichstein or English magnesian limestone of the permian. Throughout the secondary rocks the same law prevails more or less; and wherever the typical limestone of a natural group is absent, there we perceive the deposits to be ill-characterised by organic remains. For example, the trias, so rich in fossil remains, when its great calcareous centre, the muschelkalk, is present, as in Germany and France, is a miserable sterile formation in Britain, where, as in our new red sandstone, no such limestone exists. Proceeding into the secondary strata, which often constitute vast mountain masses, we pass first through the trias, then traverse the lias, and afterwards the long series of the oolitic or jurassic formations, all of which are charged with many animal and vegetable remains, and laden with a great profusion of curious and large saurians, *very unlike* the lizards which *preceded* them. Besides numerous land plants, *insects* now become abundant—a tribe which began to appear in the carboniferous era, or in the first great forests; and with these are found bones of that large winged reptile—the "pterodactyle"* of geologists.

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* πτερον, a wing; δαχτυλος, a finger.

But still surrounded, as we are, in these secondary strata, by the spoils of the land, we have to journey through nearly a half of them, before we obtain any other evidences of the existence of mammalia, than two or three teeth of a carnivorous animal, said to be found in a bone bed of the trias, (but which may possibly be the bottom bed of the lias,) and the scarce fragments, in the Stonesfield oolite, of the amphitherium, formerly named didelphis bucklandii by Brodrip. This last-mentioned creature, which is allied to living marsupials, though discovered many years ago, has had no companions added to it by the hordes of collectors who have sought for them, except the small but highly curious phascolotherium of Devon. The eminent naturalist, Owen, remarks on the absence of mammalia in the older rocks: "Had mammalia existed in the same number and variety in the ancient forests that have contributed to the coal strata, as in the actual swamps and woods in the warmer parts of the globe: had armadillos and ant-eaters been then created to feed on insects, sloths on the leaves, and monkeys on the fruits of the coal plants, as they do now in the Brazilian forests, where the mammals preponderate over the reptiles, we might have expected the first evidences of an air-breathing vertebrate animal to have been a mammalian.

"After this, we have plentiful evidences of successive shore deposits at many periods, with abundant examples of sediments formed in lakes and rivers, (an order of things of which vestiges were first apparent towards the close of the primeval period,) and with continual signs of adjacent lands affording numerous forms of plants and insects. The Wealden, of such vast thickness, is indeed exclusively tenanted by land and fresh-water remains; and yet, although its strata are full of plants and the gigantic fossil lizards of the period, not one bone of a mammal has been exhumed from them; while bones of birds make their appearance first only in green-sand and chalk.

" We have to work through the whole cretaceous series and its prolific fauna, to take leave, in short, of the secondary rocks, and enter upon the tertiary epochs, before such remains are at all plentiful. Then, for the first time in this incalculably long series of formations, we have before us, on all sides, the bones of the higher order of mammalia; and these having been drifted from adjacent lands, are constantly associated with the exuviæ of marine creatures, which, though of classes known in the earlier formations, *are entirely different* in species. Animals of every sort abound in each succeeding formation, and exhibit an increasing *quantity and variety* of both sea and land mammalia, as we approach the superficial accumulations. In the last are entombed the bones of gigantic quadrupeds—quadrupeds which once inhabited our present continents, and which must have required for their sustenance a range over lands as extensive as those now occupied by man and his associates." We have now learned the conclusions to which the geologist has arrived from palpable evidence ; we shall also discover that naturalists are forced to like conclusions. "We discern," says Mr. Owen, "the earliest trace of warm-blooded, air-breathing viviparous quadrupeds, at that remote period when the deposition of the oolitic group of limestones had commenced. The massive evidence of the operations of the old ocean, from which those rocks were gradually precipitated, extends across England, from Yorkshire on the north-east, to Dorsetshire on the south-west, with an average breadth of nearly thirty miles ; and from the same land which formed the shore of this arm of the sea, were washed down the remains of small insectivorous and probably marsupial quadrupeds, *distinct in genus and species from any now known in the world.* With these small mammals there occur elytra of beetles, and debris of cycadeæ and other terrestrial plants. The character of some of the vegetable fossils and of the associated shells, as the trigonia for example, and the great abundance in the oolitic ocean of fishes, whose nearest *living* analogue is the Port Jackson shark, (*cestracion,*) recall many of the characteristic features of *actual organic life in Australia.*

In contemplating, however, the frail and scanty, but precious evidence, of the ancient oolitic insectivora, we naturally ask, could the link of the mammalian chain of being have existed detached and insulated? Were there then no representatives of carnivorous phylacines and dasyures to enjoy life at the expense of the quick-breeding little phascolotheres and amphitheres? We can scarcely resist the latent conviction of such an association, notwithstanding the absence of direct proof, since we find so many indications of coeval conditions, apparently favourable for the developement of all forms of organic life; and it is plain from the scarce and fragmentary parts of the skeletons of the hitherto discovered Stonesfield mammalia, that many circumstances concurred to destroy or conceal such evidences. The non-discovery of the remains of marine mammalia is more conclusive as to their non-existence. Had whales, grampuses, porpoises, or manatees existed in the oolitic ocean, it is highly improbable that every trace of their bones and teeth should have escaped notice, especially when the remains of cetiosauri and other reptilian inhabitants of those ancient seas are so abundant. From the remote period in which the remains of mammals first make their appearance, to that in which we again get indubitable evidence of their existence, a lapse of time incalculably vast has occurred. We trace it by the successive deposition from seas and estuaries, of enormous masses of rocks of various kinds—the grave-yards of as various extinct forms of animal and vegetable life. The shelly limestone of Stonesfield, which contains the bones of the amphitheria and phascolotheria, lies upon inferior oolite. Upon it have been accumulated the strata of the great oolite, the cornbrash and the forest marble; and upon these have been successively piled the Oxford group of clay, calcareous grit, and coral rag, the Kimridge clay, and Portland stone. In the extensive range of Wealden rocks, deposited after the formation of the Portland sands by the waters of an immense estuary, and rising to the height of eight hundred feet, no true indication of warm-blooded animals have been hitherto discovered. Four hundred feet deep of gault and greensand rest upon the Wealden, but yield no trace of cetacean or other forms of mammalian life.

Over these foundations of the present south-eastern part of England the ocean continued to roll; but, under influences of heat and light, favourable to the developement of corals and microscopic shells, during a period of time which has permitted the successive accumulation of layers of these skeletons, in a more or less decomposed state, with probably additions from sub-marine calcareous and silicious springs, to the height of one thousand feet. But though amongst the remains of higher organised animals that have become enveloped in the cretaceous deposits, there have been recognised birds, pterodactiles, and a land lizard, probably washed down from a neighbouring shore, no trace of a mammalian quadruped has yet been discovered in them. The surface of the chalk after it had become consolidated, was long exposed to the corroding action of waves and currents. Into deep indentations so formed, have been rolled fragments of chalk and flint, with much sand. The perforations of marine animals on that surface have been filled with fine sand ; and there are many other proofs of the lapse of a long interval of time between the deposits of the chalk deposits of Britain, and the commencement of the next or tertiary era. Of this era our present island gives the first indication, in traces of mighty rivers, which defiled the fair surface of the rising chalk, by pouring over it the debris of the great continent which they drained—a continent which has again sunk, and probably now lies beneath the Atlantic.

The masses of clay and sand that have been thus deposited upon the chalk, are accumulated chiefly in two tracts, called the London and Hampshire basins, which seem to have been two estuaries or mouths of the great river : the one extends from Cambridgeshire, through Hertfordshire and Suffolk, to the North Downs ; the other from the South Downs, along the range of chalk hills, into Dorsetshire. Some parts of these deposits attain the height of more than one thousand feet, indicating the great depth of the ocean into which they were poured.

At the time when these vast, but gradual (?) operations were taking place, an arm of the sea extended from the north, to the area called the Paris basin, which received the overflow of a chain of lakes extending thither, from the highest part of the central mountain group of France. An enormous mass of mixed or alternating marine and fresh water deposits was accumulated in this basin, coeval, if we may judge from the species of shells, with the outpouring of the London and plastic clays upon the English chalk. Each division of the French eocene deposits is characterised either by the exclusive possession or the predominance of the particular fossils, and the entire series must have required a long lapse of ages for its accumulation. Yet the *sudden* introduction, as it seems, of various forms of mammalia, *at this period* of the earth's history, corroborates the inference, from more direct evidence, of the long interval of time that elapsed between the cessation of the British chalk formation, and the commencement of the tertiary deposits. The proofs of the abundant mammalian inhabitants of the eocene continent were first obtained by Cuvier, from the fossilised remains in the deposits that fill the enormous Parisian excavation of the chalk. But the forms which that great anatomist restored *were all new* and strange, and for the most part generally distinct from all known existing quadrupeds. By these animals the naturalist was first made acquainted with the aquatic cloven-hoofed animal, which Cuvier has called anoplothere, and with its light and graceful congeners, the dechobunes and xephiodon, with the great paleotheres, which may be likened to hornless rhinoceroses, with the more tapiroid lophiodon, with the large peccari-like pachyderm called chœropotamus, with about a score of other genera and species.

Long before any discovery had been made of remains of terrestrial animals in the contemporary London and plastic clays, the existence of neighbouring dry land had been inferred, from the occurrence in those deposits of bones of crocodiles and turtles, and from the immense number of fossil seeds and fruits, resembling those of *tropical* trees, as pandani, cocoa-nut, &c. The remains of a few of the mammals of the ancient palm-groves, that bordered the mighty eocene river or estuary, have since been recovered from its sediments. One of these quadrupeds is a lephiodon, another a nearly-allied pachyderm, (coryphodon,) larger than any existing tapir; a third (hyracotherium) has the closest affinity to the chœropotamus, but was not much larger than a hare. In a sandy deposit, probably near the margin of the estuary, and where Kingston in Sussex now stands, the remains of a smaller species of hyracothere, about the size of a rabbit, have been found, and both here and in the eocene clay at Sheppey and at Brocklesham, vertebræ of large serpents, like the boa constrictor, have been discovered. The combination of organic remains in these vast accumulations of the detritus of the eocene continent, is in fact quite analogous to what may be expected to be found in the outpourings of the Ganges or the Amazon, when those sedimentary deposits are in their turn raised from the bed of the recipient ocean and made dry land.

Scanty as are the eocene mammalia hitherto discovered in the London clay, they are highly interesting from their identity or close affinity with some of the peculiar extinct genera of the Paris basin. In the fresh water and marine beds at the north side of the Isle of Wight, and at the opposite coast of Hampshire, there occur the remains of the same species of quadrupeds as have been found in the contemporaneous Parisian formations. One of the rarest and most remarkable of the pachyderms, whose peculiar characters were obscurely indicated by Cuvier, from scanty fossils yielded by the Montmartre gypsum, has had its claim to generic distinction established, and its nature and affinities fully illustrated by more perfect specimens from the eocene limestone of the Isle of Wight: in no other part of Great Britain has any portion of this animal, the chœropotamus, been found, except in the above limited locality, which alone corresponds with the formation of the Paris basin in mineral character as in date of origin. This discovery becomes, therefore, peculiarly interesting and suggestive. For were the common notion true, that all the fossil remains of quadrupeds not now existing in England, had been brought hither during a single catastrophe, and been strewed with the detritus of a general deluge over its surface, what would have been the chance of finding the solitary bone of a chœropotamus in the very spot, and in the very limited locality where alone in all England the same kind of fresh water deposits existed as those in which the unique upper jaw of the same extinct species had been found in France. With chœropotamus are associated, in the Binstead and Seafield quarries of the Isle of Wight, remains of anoplotherium, dichobune, palæotherium, and lophiodon, shewing, with the fossils from the London clay, that the same peculiar generic forms of the class mammalia prevailed during the eocene epoch in England as in France.

Almost the sole exception to the generic distinction of the eocene mammalia, which occurred in the researches of Cuvier, was the famous didelphys of Montmartre; and what made this discovery the more remarkable, was the fact that all the known existing species of that marsupial genus *are now* confined to America, and the greater part to the southern division of that continent. An opossum appears to have been associated with the peccari-like hyracotherium in the eocene sand of Suffolk; where, likewise, some teeth of a monkey, apparently a macacus, have been found. It is not uninteresting to remark that the peccari, the nearest exist[illegible] ally to the old hyracothere, is like the opossum, *now* peculiar to America; and that two species of tapir, the nearest living allies to lophiodon, exist in South America. We gain little, however, from the comparison of the eocene with the existing mammalia, in reference to their geographical distribution, except a strong indication that the relative distribution of land and sea, as well *as the climate* of English latitudes, *were then widely different* from what they are at the present day.

The marine deposits of the eocene epoch, in contrast with those of the preceding secondary periods, also bespeak the great advance of animal life, and shew the remains of great whales. Petrified cetaceous bones have been found *in situ* in the London clay at Harwich; and similarly petrified teeth and ear-bones (cetotolites) have been washed out of the eocene clay into the red-crag at Felix-stow. These fossils belong to species distinct from any known existing cetacea, and which, probably, like some of the eocene quadrupeds, retained fully developed characters, which are embryonic and transitory in existing cognate mammals. *With the last layer of the eocene deposits we lose in England every trace of the mammalia of that remote period.* The imagination strives in vain to form an idea commensurate with the evidence of the intervening operations which continental geology teaches to have gradually and successively taken place: of the length of time that elapsed before the foundations of England were again sufficiently settled, to serve as the theatre of life to another race of warm-blooded quadrupeds. The miocene basins of the Danube and the Rhine and the valley of the Bormida, attest the share which the sea took in the contribution of these deposits, between the end of the eocene period, and the time when we again find mammalian fossils in England. Lake and rivers intercalated their sediments with those of the sea, as at Saucats, south of Bordeux; whilst active volcanoes, in Auvergne, Hungary, and Transylvania, were adding their share of solid matter to the rising continent.

In his usual forcible and startling language, the Rev. Mr. Kingsley has combined these several facts together, and points out, in strict accordance with the declaration of the ablest and best geologists and naturalists, that the course of this world has been so ordered and governed, that the harmony between its inorganic and physical masses, and its animate and organised occupants, had never once been disturbed.

In his admirable lecture at Bristol, Mr. Kingsley says:—"Let us go out (in fancy, for it is too cold and dark to go in any thing else) into one of the gravel-pits. The gravel-pit I would take would be one of those situated on the Great Western Railway, between here and Twyford. The first thing we see is a quantity of rounded stones, lying in sand upon clay. Well, what do those stones tell you? Let us ask those stones, how did you come here, and whence did you come from? I am afraid that, the stones having no tongues, I must answer for them, and say these are ancient venerable worthies. They have seen a great deal in their time. They have had a great deal of knocking about, and have stood it manfully. In fact they have stood the knocking about of three worlds before this one, and have done their duty therein, and are ready and willing to be knocked about in a fourth, and will do their duty there too. Three worlds? Yes, I must answer for the stones still. Standing there in the gravel-pit, I see three old worlds, in each of which these stones played their part, and this world in which we now live is the fourth. Three worlds? I speak the truth. Let me explain the solemn truth step by step. You see the chalk hills to the north, and the range of chalk hills, running for many a mile, from Newbury through Pangbourne, away to Caversham, and so running to the north. These represent one world. You know the clays and sands that lie to the south, through Shinfield, Arborfield, Hartford Bridge Flat, and Windsor; that is what I called the second world. Then you see beds of gravel and upper soils, spread over the length and breadth of the country, to the north, from the gravel-pit in which you stand, right over Ascott Heath, to the Beacon-hill at Farnham. This is the third world. Let us take them one by one. First the chalk. The chalk hills rise much higher than the surrounding country, but you must not suppose for that reason that they were made after it, laid upon the top of the sands and clays.

"We are in what we may call a chalk basin in this locality, or rather half a basin, which begins below Lord Carnarvon's park at Highclere, and runs to the eastward, widening gradually till it meets the eastern sea below London, running every where under London and throughout the low country round London, both to the north and south. The chalk basin is filled, or rather half filled, with clays and sands. But what has this to do with the gravel-pit? This, first—that all flints in this pit have come out of the chalk. They are coloured by the oxide of iron, which has turned them rusty red, instead of their original white or grey, but they are exactly the same flints as you will find in the chalk-pit on the other side of the town. How do I know that? Our own eyes will prove that; but a still surer proof exists when you break or slice them, you find exactly the same fossils in them. I told you that each flint was moulded, so it seems, round the body of some living thing, animal or vegetable, which had bred at the bottom of the chalk ocean. I told you also that you would find in the pebbles the shells of many animalcules. On many of them you will find the prints of large shells; on others bits of coral either embedded in the flint or sticking to it. You may find some very interesting details on this subject in a little book called 'Mantell's Thoughts on a Pebble,' which I wish most particularly to recommend to you, and which I think no Mechanics' Institute or school-room should be without. You will find these pebbles then exactly alike in the chalk-pit and gravel-pit; and the natural conclusion then is, that the gravel has been produced from the washings of the chalk. The white lime of the chalk has been carried away in solution in water by some flood or floods; the flints have been left behind, and the round and polished shape of many of them shows plainly that they have been rolled about for a long time at the bottom of the sea; perhaps, as they have been found near Reading, they have been beaten on the shore of some old sea beach, till they have lost their original form and are broken up into round pebbles. These facts have been worked out, one by one, by many men labouring in many parts of England, and the continent also, for the last forty years. Look at the magnificence of the results? We know what chalk is—how chalk was formed. We know that it was deposited as white-lime mud, at the bottom of an ancient sea—seemingly a deep one, undisturbed by storms or currents; we know that not only the flint, but the chalk itself, is made up of shells. I do not mean that you will find shells in it, but that it is shells. The shells of little microscopic animalcules and vegetables, smaller than a needle's point, in millions of millions, some whole, some broken, some in powder, which lived, and died, and decayed for ages on the bottom of the great chalk sea. Their numbers none can count, but Him who made them. Three or four millions of them have been counted in one small ounce of sand.

"We know this, I say. We had suspected it long, and became more and more certain of it as the years went on. But within the last few months we have had a confirmation of this suspicion more complete than ever. In the late survey of the bottom of the Atlantic ocean, with a view to laying down the electric telegraph between England and America, by Lieutenant Keans, of the American service, science was not forgotten. A sounding-lead was invented, which would bring up safely specimens of the mud and sand from the bottom. And the result is, that the floor of the Atlantic, after you have left the land a few miles, is one vast plain of mud and sand, extending over 1,300 miles in length. But here is the wonder—at a depth averaging 1,600 fathoms—9,600 feet—in utter darkness, the sea floor is covered with countless millions of animalcules of the same family (though not the same species) as those of the chalk. Whether, both in the Atlantic and the chalk ocean, these tiny wonders live at the bottom, in total darkness from birth to death, or whether they swim freely at all depths, and their shells, after they die, sink down, to add ever fresh layers to the floor below, we do not yet know. There is reason to suspect the latter, but till we have facts we must not indulge in guesses. But our chalk is still at the bottom of the sea. How did it become dry land? By the upheaving force which causes earthquakes—when it acts in a single shock, snapping the layers of the earth's crust by an explosion; but which acts, too, quietly and slowly, uplifting day by day, and year by year, some parts of the land, and letting others sink as gradually. That these upheaving forces were much more violent and powerful in the earlier epochs of our planet, we are certain; and we have good reasons already to show why they must have been so, but the subject is too long and too obscure to enter on here. The reverend gentleman then described the formation of the clays and sands, which he denominated the second world, and proceeded to say—But do not suppose that we have yet got our gravel-pit made, or that the way-worn pebbles of which it is composed are near the end of their weary journey. Poor old stones! driven out of their native chalk, rolled for ages on a sea beach, they have tried to get a few centuries' sleep in the sands, on the top of the chalk hills behind us, while the London clay was being deposited peacefully in the sea below. And behold they are swept out once more, and hurled pell-mell upon the clay, three hundred feet over our heads—over our heads, remember. We have come now to a time when Hartford-bridge flats stretched also over Winchfield and Dogmersfield. What broke them up? What furrowed out their steep side valleys? What formed the magnificient escarpment of the Beacon-hill, or the lesser one of Finchampstead ridges? What swept away all but a thin cap of them on the upper part of Dogmersfield Park, and another under Winchfield-house, another at Bearwood, and so forth. The convulsions of a third world, more fertile in animal life than those which preceded it, and which also was more terrible and rapid, if possible, in its changes. Of this the third world (the one which, so to speak, immediately preceded our own) we know little as yet—its changes are so complicated that geologists have as yet hardly arranged them.

"But what we can see I will sketch for you shortly. A great continent to the south, England probably an island at the beginning of the period united to a continent by new beds, the mammoth ranging up to where we now stand. Then a period of upheaving. The German Ocean becomes dry land. The Thames, a far larger river than now, runs far eastward to join the Rhine and other rivers which altogether flow northward in one enormous stream, toward the open sea between Scotland and Norway. And with this a new creation of enormous quadrupeds, as yet unknown. Countless herds of elephants pastured by the side of that mighty river, where now the Norfolk fisherman dredges their flesh and bones, far out in open sea. The hippopotamus floundered in the Severn, the rhinoceros ranged over the southwestern countries, and enormous elks and oxen, species now extinct, inhabited the vast fir and larch forests which stretch from Norfolk to the furthest part of Wales. Hyænas and bears, double the size of our modern ones, and here and there the great sabre-toothed tiger, now extinct, prowled out of the caverns in the limestone hills to seek their bulky prey. We see, too, a period—whether the same as this or after it I know not yet—in which the mountains of Wales and Cumberland rose to the limits of eternal frost, and Snowdon was indeed Snowdon, an alp down whose valleys vast glaciers spread far and wide ; while the reindeer of Lapland, the marmount of the Alps, and the musk ox of Hudson's Bay, fed upon alpine plants, a few of whose descendants still survive as tokens of the long past age of ice. At every successive upheaval of the western mountains, the displaced waters of the ocean swept over the lower lands, filling the valley of the Thames with vast beds of drift gravel, containing among it chalk flints and fragments of stone from every rock between here and Wales, teeth of elephants, skulls of oxen and musk oxen ; while icebergs, breaking away from the glaciers of the Welsh Alps, sailed down over the spot where we now are, dropping their embedded stones to confuse more utterly than before the records of a world rocking and throbbing above the shocks of the nether fire.

"At last the convulsions get weaker, the German Ocean becomes sea once more, the northwestern Alps sink again to a level far lower even than their present one, only to rise again, and not so high as before. Sea beaches and sea shells fill many of our London valleys, whales by thousands are stranded, as in the Farnham valley, where is now dry land. Gradually the sunken land begins to rise again, and falls perhaps again, and rises again after that, more and more gently each time, till, as it were, the panting earth, worn out with the fierce passions of her fiery youth, has sobbed herself to sleep once more. And this new world of man is made, and among it—I know not when—was deposited our little gravel-pit, from which we started on our journey through three worlds. Enough for us that He knows when—in whose hands are the times and the seasons, God the father of the spirits of all flesh."

Dr. Carpenter, in his excellent and instructive work on zoology, remarks: "There is abundant evidence, derived from the fossil remains which occur in the newer tertiary strata, (those that lie above the chalk,) in gravel beds and in caves, that the larger *feline* and *hyænine* animals were formerly distributed much more extensively: that lions and tigers of *greater bulk* than any at present existing, formerly roamed over the plains, and inhabited the jungles of Europe, and even of our own country (England); and that gigantic hyænas and enormous bears dwelt in the caves, which occur so frequently in our limestone rocks, dragging thither the carcases of the animals they had slaughtered, and prowling about by night, with glaring eyes and savage howls, in search of prey. In a fissure recently laid open on Durdham Downs, near Bristol, are found, besides numerous other remains, teeth of hyænas, as much surpassing in size those of the largest tiger now existing, as these last exceed those of the largest hyæna. In many of the caves are now found vast heaps of bones of the animals thus destroyed, which must have accumulated during many years, together with the bones of the rapacious beasts which had their dwelling there; and it is a remarkable proof that these caves really were the dens of hyænas, and that the collection of bones found in them were not merely washed into their entrances by some great convulsion, which swept these races from this part of our globe, but that many of the bones of the oxen, antelopes, deer, &c., which accompany them, bear the distinct marks of hyænas' teeth; and that the fossilised excrements of these last animals (which, like those of other carnivora, are nearly white, consisting of little else than bone earth) have been clearly recognised. The existence of these gigantic carnivora in what are now the temperate regions of the globe, seems clearly to indicate that the climate of these parts must have been formerly much warmer than at present. It is further interesting to remark that, as at the present time, we only find the larger carnivora existing in countries inhabited by large species of herbivorous quadrupeds, on which they may prey as in former epochs; we never find the one set of races present without the other—the herbivorous to supply the carnivora with food—the carnivora to restrain the otherwise excessive multiplication of the herbivora, and to remove their decomposing remains from the surface of the earth." Again, "Fossil remains of marsupials (kangaroo and opossum race) have been found in the bone caves of Australia, in which country their remains might be fairly anticipated. But there is evidence that this order was formerly diffused more widely over the globe than it is at present; for remains of animals which unquestionably belonged to it, have been found in Europe, and even in England. Bones of an opossum were found by Cuvier in the gypsum-beds of Montmartre, near Paris; and portions of the lower jaws of two opossum-like animals have been discovered in the oolite of Stonefield, in Oxfordshire. These last remains have given rise to much discussion; some eminent anatomists having maintained that they are not the remains of mammals at all, but of animals of the reptile class. But the question may now be considered as finally settled; since the examination of the microscopic structure of the teeth has shewn that it corresponds exactly with that of marsupials, and differs entirely from that of any reptiles. It is extremely interesting to remark that these remains occur in strata much lower (and therefore older) than those in which any other remains of mammalia are found; whence it may be concluded that ovo-viviparous sub-class was called into existence at an earlier period in the history of the globe, than that at which the true mammalia were created." Some remains of gigantic pachyderms, that seem to have been intermediate between the mastodon and the dinotherium, have been recently brought from Australia, in some parts of which they are said to abound. "They tell us plainly," says Prof. Owen, "that the time was when Australia's arid plains were trodden by the hoofs of heavy pachyderma: but could the land have been as now, parched by long-continued droughts, with dry river courses, containing here and there a pond of water? All the facts and analogies which throw light on the habits of the extinct mastodons and dinotheres, indicate these creatures to have been frequenters of marshes and swamps, or lakes. Other relations of land and sea than now characterise the southern hemisphere —a different condition of the surface of the land, and of the meteoric influences governing the proportion of fresh water on that surface, may therefore be conjectured to have prevailed when huge mastodonoid pachyderm constituted part of the quadrupedal population of Australia; and a change from a humid climate to the present particularly dry one, may have been the cause, or chief cause, of the extinction of the race."

Again, in contrasting the fossil with recent specimens of crocodilia, Mr. Owen observes: "On reviewing the information which we have derived from the study of the fossil remains of the pro-cœlian crocodilia, that have been discovered in the eocene deposits of England, the great degree of climatal and geographical change which this part of Europe must have undergone since the period when every known generic form of that group of reptiles flourished here, must be forcibly impressed on the mind. At the present day the conditions of earth, air, water and warmth, which are indispensable to the existence and propagation of these most gigantic of living saurians, occur only in the tropical or warmer temperate latitudes of the globe. What must have been the extent and configuration of the eocene continent, which was drained by rivers that deposited the masses of clay and sand, accumulated in some parts of the London and Hampshire basins to the height of one thousand feet, and forming the grave-yard of countless crocodiles and gavials? Whither tended that great stream, once the haunt of alligators and the resort of tapir-like quadrupeds, the sandy bed of which is now exposed on the upheaved face of Hordwell cliff? Had any of the human kind existed and traversed the land where now the base of Britain rises from the ocean, he might have witnessed the gavial cleaving the waters of its native river with the velocity of an arrow, and ever and anon rearing its long and slender snout above the waters, and making its banks re-echo with the loud and sharp snappings of its formidably armed jaws. Our fossil evidences supply us with ample materials for the most strange picture of animal life of Great Britain, and what adds to the singularity of the restored 'tableaux vivant,' *the fact that it could not now be presented* in ANY PART OF THE WORLD. The same forms of crocodilian reptile, it is true, still exist, but the habitats of the gavial and the alligator are wide asunder, thousands of miles of land and water intervening: one is peculiar to the continental rivers of tropical Asia, the other is restricted to the warmer latitudes of north and south America: both forms are excluded from Africa, in the rivers of which continent true crocodiles alone are found. Not one representative of the crocodilian order naturally exists in any part of Europe; yet every form of the order once flourished in close proximity to each other, in a territory which now forms part of England."

Surely we have evidence here which cannot be refuted, evidence which convinces us that the whole universe—its whole as well as its particular parts, are and have been the constant care and designed appointment of an All-Wise, All-Powerful, ever present Power. A little reflection on the important events which have been revealed, must carry home the conviction that, amid all the changes which the world, in its inorganic elements, has passed through, there has been a Mind ever directing and controling those changes, and so arranging events, as to produce the most supernatural displays of wisdom and goodness. Rocked in the cradle of the deep, the submerged land has heaved and tossed in its watery bed, until at length, as if struggling to be free, its mighty head has been reared beneath the waste of waters; now with sudden start, now with more silent, but not uncertain effort. There is nothing to warrant us in believing that the order observed in the changes of the earth has been always uniform; indeed the nature of the evidence leads to a contrary belief; for when it is discovered that there is a law which requires the adaptation of the creature to the medium in which it is to live; another determining not only the life—or, rather, length of days—of the being, as well of the genera, order, class or family; and yet another determining the re-arrangement of the earth on which these beings live; we cannot, with Mr. Lyell, suppose that those several changes have always been effected with uniformity, and invariably accomplished through long periods of time. But whatever may have been the rate of change which pertained to the inorganic world, no geologist or naturalist for a moment supposed that the change observed in animal and vegetable forms, was the result of a process of gradual developement of one form into another: on the contrary, we have adduced abundant evidence to prove, while in each succeeding age the plan of creation became as it were unfolded, its various parts so clearly shewing the necessity for a yet further becoming, that the anatomist reads in the mighty scheme a faultless perfection and adaptation, which fills the mind with wonder. Who can deny that stupendous might and comprehensive intelligence must have been engaged in fashioning those animate existences which we see in turn to have peopled the earth in the respective epochs through which it has passed, telling plainly that at each period life was clothed upon with special forms—was a distinct life period, which had its own special appointment and its own length of days, and we learn that whatever may have been the peculiar changes of the earth, those changes were first effected to fit it for the reception of new creations of beings.

Geologists and naturalists confess that the close of the tertiary and the dawn of the quarternary periods are so blended, that it is difficult to fix the precise line of demarcation between them; but we believe that much of the difficulty may be removed by re-calling to mind the fact that, as there has always been a bringing forward as it were of events and an amplification of plan, the progression from "the general to the special," so at last it must come to pass that the similarity observed between younger epochal creations would be more apparent. As Sir R. Murchison has pointed out, in the earlier history of the earth we have a more general diffusion of animal and vegetable life, as in the carboniferous; while, in the oolite, we find a more geographical centralisation of species: thus, speaking of the distribution of animal life, Prof. Owen remarks: "It would appear from comparisons, which the present state of palæontology permits to be instituted between the extinct mammalian fauna of other great natural divisions of dry land, that these divisions severally possessed a series of mammalia as distinct and peculiar in each, during the pliocene period, as at the present day.

"Additional facts and the means of extending our comparisons, by the collection of fossils of distant lands, are most desirable, in order to precisely define the laws of the geographical distribution of mammalia of the older and newer pliocene periods; and to speak of the sum of the present observations, under the term 'law,' may, perhaps, be deemed premature. But the generalisation first enunciated in my report to the British Association, in 1844, seemed to be sufficiently extensive and unexceptionable, to render them of importance in a scientific consideration of the present distribution of the highest organised and last created class of animals; and to shew that, with extinct as with existing mammalia, particular forms were assigned to particular provinces; and, what is still more interesting and suggestive, *that the same forms were restricted to the same provinces at the pliocene periods, as they are at the present day.* In carrying back the retrospective comparison of recent and extinct mammals, to those of the eocene and oolitic strata, in relation to their local distribution, *we obtain indications of extensive change* in the relative position of sea and land during *those epochs*—in the degree of incongruity between the generic forms of the mammalia which *then* existed in Europe, and any that actually exist on the great natural continent of which Europe forms a part. It would appear, indeed, from our present knowledge, that the further we penetrate into time for the recovery of extinct mammalia, the further must we go into space for their existing analogues. To match the eocene palæotheres and lophiodons, we must bring tapirs from Sumatra or South America; and we must travel to the antipodes for myrmecobians and dasyures, the nearest living analogues to the amphitheres and phascolotheres of our oolitic strata."

To form adequate ideas, says Agassiz, of the great physical changes which the earth has undergone, and the frequency of these modifications of the character of the earth's surface, and of their coincidence with the changes observed among the organised beings, it is necessary to study attentively the works of Elie de Beaumont; he, for the first time, attempted to determine the relative ages of the different systems of mountains, and shewed first, also, that the physical disturbance, occasioned by their upheaval, coincided with the disappearance of entire fauna, and the re-appearance of new ones. While the genesis and genealogy of our mountain system was thus illustrated, palæontologists extending their comparisons between the different formations to all the successive beds of each great era, have observed more and more marked differences between them, and satisfied themselves that fauna have been more frequently renovated than was formerly supposed; so that the general results of geology proper, and of palæontology, concur in the main to prove that, while the globe has been, at repeated intervals, and, indeed, frequently, though after immensely long periods, altered and altered again, until it has assumed its present condition; so have also animals and plants, living upon its surface, been again and again extinguished and replaced by others, until those now living were called into existence, with man at their head. The investigation is not in every case sufficiently complete to *shew every where* a coincidence between this renovation of animals and plants, and the great physical revolutions which have altered the general aspect of the globe; but it is already extensive enough *to exhibit a frequent synchronism* and *correlation*, and to warrant the expectation that it will in the end lead to a complete demonstration of their mutual dependence, *not as cause and effect*, but as steps in the same progressive developement of a plan which *embraces* the *physical* as well as the *organic* world. In order not to misapprehend the facts, and perhaps to fall back upon the idea that these changes may be the cause observed between the fossils of different periods, it must be well understood that, while organised beings exhibit through all geological formations a regular order of succession, this succession has been from time to time violently interrupted by physical disturbances, without any of these altering in any way the progressive character of that succession of organised beings. Truly this shews that the important, the leading features of this whole drama, is the developement of life; and that the material world affords only the elements for its realisation. The simultaneous disappearance of entire fauna, and the following simultaneous appearance of other fauna, shew further that, as all these fauna consist of the greatest variety of types, in all formations, combined every where into natural associations of animals and plants, between which there have been definite relations at all times; their origin can at no time be owing to the limited influence of monotonous physical causes, ever acting in the same way. Here, again, the intervention of a Creator is displayed, in the most striking manner, in every stage of the history of the world: the sudden introduction of life forms effected, and adaptation between these and the inorganic world preserved. Years may, in some cases, have been expended in the preparation of the earth for living creatures, while the introduction of the creatures has been sudden, and in accordance with the condition of earth.

From testimony, such as the naturalist and geologist has offered, and which we have now had before us, how can any one doubt that the respective creations, which have been introduced on the earth, are each in themselves distinct, and have been severally fashioned in completion of a stupendous plan. How it is that some men, who have pondered on the harmonious operations of the Creator's will, fail to discover that, at some times, during the preparation of the inorganic earth, there have been intervals of rest from organic creation, (as pointed out by Owen,) and as shewn from the very necessities of the case, we are at a loss to explain: but it would appear that at times they wrote as if fully persuaded of the doctrine of Le Marc. Yet it is now very well known that such doctrine has no foundation whatever, in nature or in fact. Indeed, what more natural than that the close of one epoch should blend its imbedded remains with those of the next overlying occupants of a succeeding age? The difficulties which have been thrown around the question can no longer embarrass the student, since it has been ably shewn by some of the most astute geologists, that the law of rigid uniformity, attempted to be established by Mr. Lyell, has utterly failed. We claim, then, the perfect right to declare that there is the best evidence furnished by geology, to prove that this earth has been renovated at different times, and that the last renovation—constituting the human or quarternary period—was a distinct and special creation, prophesied and typified by the animal and vegetable beings which, in preceding epochs, had replenished the world.

We will, briefly as may be, furnish the evidence of prophetic annunciation through animal types: here, again, we have to seek for the facts from Owen, Agassiz, Miller and Knox.

"Several authors," says Agassiz, "have already alluded to the resemblance which exists between the young of some of the animals now living, and the fossil representatives of the same families in earlier periods. But these comparisons have thus far been traced only in isolated cases, and have not yet led to a conviction, that the character of the succession of organised beings in past ages, is such in general as to shew a remarkable agreement with the embryonic growth of animals; though the state of our knowledge in embryology and palæontology *justifies now* such a conclusion." In examining the agreement between this succession, and the phases of the embryonic growth of living animals, we may therefore take for granted, that the order of succession of their fossil representatives is sufficiently present to the mind, to afford a satisfactory basis of comparison. No class affords, as yet, a more complete and more beautiful evidence of the correspondence of their embryonic changes, with the successive appearance of their representatives in past ages, than the echinoderms. Prior to the publications of J. Muller, the metamorphosis of the European comatula alone was known. This had already shewn that the early stages of growth of the echinoderm exemplify the pedunculated crinoids of past ages. I have myself seen further, that the successive stages of the embryonic growth of comatula, typify, as it were, the principal forms of crinoids which characterise the successive geological formations; first it recalls the cistoids of the palæozoic rocks, which are represented in its simple spheroidal head: next, the few-plated platycrinoids of the carboniferous period; next, the pentacrinoids, of the lias and oolite, with their hosts of cirrtic, and, finally, when freed from its stem, it stands as the highest crinoid, as the prominent type of the family in the present period. The investigations of Muller upon the larva of all the families of asteroids and echinoids, enable us to extend these comparisons to the higher echinoderms. The first point which strikes the observer in the facts ascertained by Muller, is the *extraordinary similarity of* so many larva, of such different orders and different families—as the aphinroids and asteroids, the echinoids proper and the spatangoids, and even the holothuroids—all of which end, of course, in reproducing their typical peculiarities. It is next very remarkable, that the more advanced larval state of echinoids and spatangoids, should continue to shew such great similarity, that a young amphidetus hardly differs from a young echinus. Finally, not to extend these remarks too far, we may add, that these young echinoids (spatangus as well as echinus proper) have rather a general resemblance to cidaris, on account of their large spines, than to echinus proper. These facts agree exactly with what is known of the successive appearance of echinoids in past ages; their earliest representatives belong to the genera diadema and cidaris; next come true echinoids, later only spatangoids. When the embryology of clypeastroids is known, it will no doubt afford other links to connect a large number of the members of this series.

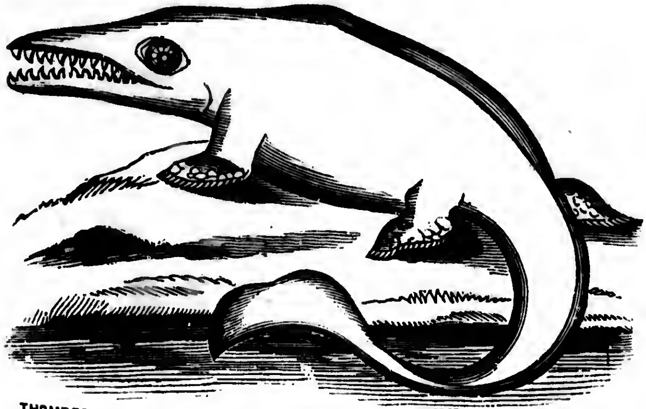
The class of crustacea is very instructive; but to trace our comparisons through the whole series, it is necessary that we should consider simultaneously the embryonic growth of the higher entromastraca, such as limulus, and that of the highest order of the class; when it will appear that, as the former recall in early life the form and character of the trilobites, so does the young crab, passing through the form of the isopods, and that of the macrouran decapods, before it assumes its typical form as brachyouran, recall the well known succession of crustacea, through the geologic middle ages and the tertiary period, to the present day. The early appearance of scorpions, in the carboniferous period, is probably also a fact to the point, if, as I have already attempted to shew, arachnidians may be considered as exemplifying the crysalis stage of the developement of insects; but for good reasons it is hardly possible to take insects into consideration. In the fossil fishes, the embryonic character of the oldest fishes has been pointed out. The only fact of importance learned of late is, that the young lepidosteous, long after it has been hatched, exhibits in the form of its tail, characters thus far only known among the fossil fishes of the Devonian system. It is to be hoped that the embryology of the crocodile will throw some light upon the succession of the gigantic reptiles of the middle geological ages, as I shall shew that the embryology of turtles throws light upon the fossil chelonians. It is already plain that the embryonic changes of batrachians coincide with what is known of their succession in past ages. The fossil birds were too little known, and the fossil mammalia do not extend through a sufficiently long series of geological formations, to afford many strong points of comparison ; yet the characteristic peculiarities of their extinct genera exhibit every where indications, that their living representatives in early life resemble them more than they do their own parents. A minute comparison of a young elephant with any mastodon, will shew this most fully, not only in the peculiarities of the teeth, but even in the proportion of their limbs, their toes, &c.

It may therefore be considered as a general fact, very likely to be more fully illustrated as investigations cover a wider ground, that the phases of developement of all living animals correspond to the order of succession of their extinct representatives in past geological times. As far as this goes, the oldest representatives of every class may then be considered as embryonic types of their respective orders or families among the living. Pedunculated crinoids are embryonic types of the comatuloids ; the oldest echinoids, embryonic representatives of the higher living families ; trilobites, embryonic types of entromastraca ; the oolitic decapods, embryonic types of our crab ; the heterocercal ganoids, embryonic types of the lepidosteous ; the andreas scheuchzeri, an embryonic prototype of our batrachians ; the zeuglodonts, embryonic sirenidæ ; the mastodonts, embryonic elephants, &c.

To appreciate fully and correctly all these relations, it is further necessary to make a distinction between embryonic types in general, which represent in their whole organisation early stages of growth of higher representatives of the same type, and *embryonic features* prevailing more or less extensively in the characters of allied genera, as in the case of the mastodon and the elephant, and what may be called hyp-embryonic types, in which embryonic features are developed to extremes in the further periods of growth, as, for instance, the wings of the bats, which exhibit the embryonic character of a webbed hand, as all mammalia have it at first, but here grown out and developed into an organ of flight ; or assuming, in other families, the shape of a fin, as in a whale, or in the sea-turtle, in which the close connexion of the fingers is carved out to the extreme. The leading thought which runs through the succession of all organised beings in past ages, *is manifested again* in the phases of the developement of the living representatives of these different types. It exhibits every where the working of the same Creative Mind, through all times, and upon the whole surface of the globe. He who said "gather up the fragments that nothing be lost," merely acted out a law which had been laid down by himself in the beginning, and which is yet in operation for the instruction of his people. An organic combination having been once perfected, is not lost, but again and again employed in the great plan of the life-world.

CHAPTER II.

We have seen how the embryonic conditions of higher representatives of certain types, called into existence at a later time, are typified, as it were, in representatives of the same types which have existed at an earlier period. These relations, now that they are satisfactorily known, may also be considered as exemplifying, as it were, in the diversity of animals of an earlier period, the pattern upon which the phases of developement of other animals of a later period *were to be established.* They appear now like a prophecy in those earlier times, of an order of things not possible with the earlier combinations then prevailing in the animal kingdom, but exhibiting in a later period, in a striking manner, the antecedent considerations of every step in the gradations of animals. Recent investigations in palæontology, have led to the discovery of relations between animals of past ages and those now living, which were not even suspected by the founders of that science. It has, for instance, been noticed that certain types which are frequently prominent amongst the representatives of past ages, combine in their structure peculiarities which, at later periods, *are only observed separately* in different distinct types—sauroid fishes before reptiles, pterodactyles before birds, ichthyosauri before dolphins, &c. There are entire families, among the representatives of older periods, of nearly every class of animals, which, in the state of their perfect developement, exemplify such prophetic relations, and afford within



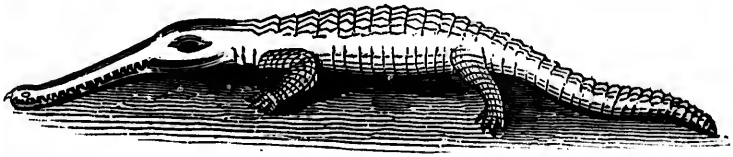
* ICHTHYOSAURUS.

the limits of the animal kingdom, at least, the most unexpected evidence that the plan of the whole creation had been maturely considered *long before it* was executed. Such types we have been in the habit of calling *prophetic types.* The sauroid fishes of the past geological ages are an example of this kind. These fishes, which have preceded the appearance of reptiles, present a combination of ichthyic and reptilian characters, not to be found in the true members of this class which form its bulk at present. Dr. Buckland's truthful description of ichthyosaurus will at once explain the importance and depth of the law which we are considering. "Near-

* ιχθυς, a fish; σαυρος, a lizard.—Approximating more nearly to the fish than the lizard.

ly," he says, "at the head of discoveries relating to the family of saurians, we may rank the remains of many extraordinary species, which inhabited the sea, and which present almost incredible *combinations* of form and structure, adapting them for modes of life that do not occur among living reptiles. These remains are most abundant throughout the lias and oolite formations of the secondary series. In these deposits we find not only animals allied to crocodiles, and nearly approaching to the gavial of the Ganges, but also still more numerous gigantic lizards, that inhabited the then existing seas and estuaries.

Some of the most remarkable of these reptiles have been arranged under the order ichthyosaurus —fish-lizard—in consequence of the partial resem-



* TELEOSAURUS.

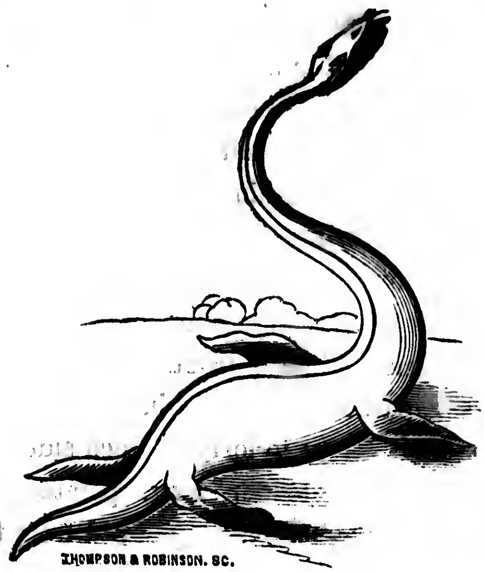
blance of their vertebræ to those of fishes. If we examine these creatures with a view to their capabilities of locomotion, and the means of offence and defence, which their extraordinary structure afforded to them, we shall find combinations of form and mechanical contrivances which *are now dispersed* through

* *τέλεος*, full grown; *σαυρος*, lizard.—Approximating more nearly to the lizard than the fish.

various classes and orders of existing animals, but are no longer united in the same genus. Thus, in the same individual, the snout of a porpoise is combined with the teeth of a crocodile—the head of a lizard with the vertebræ of a fish, and the sternum of an ornithorincus with the paddles of a whale. The general outline of an ichthyosaurus must have more nearly resembled the modern porpoise and grampus. It had four broad paddles or feet, and terminated behind in a long and powerful tail. Some of the largest must have exceeded thirty feet in length.

TELEOSAURUS.—In the oolite of England and the continent, the remains of a genus of extinct reptiles, having, like the recent gavial, long slender muzzles, have been discovered in several localities. These fossils consist of the osseous scutes of an imbricated dermal cuirass; of the cranium and jaws, with the teeth; of the vertebral column, and many other bones. The character of the dermal scutes, and of the muzzle, with its terminal nasal apertures, are as follows: the outer surfaces are marked with small circular distinct pits; these scutes are thicker and more rectangular than goniopholis, found at Swanage, and they slightly overlapped each other laterally; the nasal apertures terminate in two orifices, (not blended into a single opening, as in the recent species,) in front of the nose.

PLESIOSAURUS.—The animals of this genus present, in their osteological structure, a remarkable deviation from all known recent and fossil reptiles; uniting the characters of the head of a lizard with the teeth of a crocodile, to a neck of inordinate length, with such modifications of the ribs, the pec-

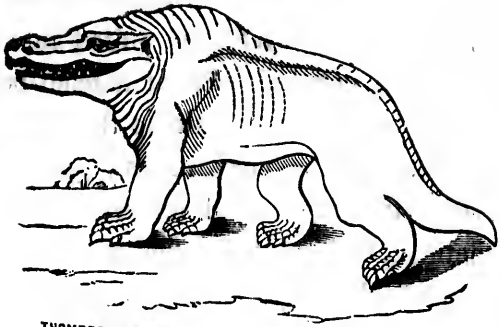


* PLESIOSAURUS.

toral and pelvic arches, and the paddles, as to justify the graphic simile of Prof. Sedgwick, that the plesiosaurus might be compared to a serpent threaded through the shell of a turtle. The character which most readily strikes the observer, is the extraordinary length of the neck, and the relative smallness of the head. The neck which, in most animals, is formed but of five vertebræ, and in the swan does not exceed twenty-four, is, in the plesiosaurus, com-

* πλησιος, almost; σαυρος, lizard.

posed of from twenty to forty; and, in some species, is four times the length of the head, and equal to the entire length of the body and tail; while the length of the head (in P. *dolichodirus*) is less than one-thirteenth the entire skeleton. The skull resembles that of the crocodile in its general form, but is relatively smaller, and is more related to the lacertian type. The parietal bone is more triquetral than in crocodiles; but the zygomatic bone is attached to its lower end. The breathing apertures are situated anterior to the orbits, on the highest part of the head. The lower jaw has the usual structure of saurians, but the dentary bone is greatly expanded anteriorly, and united in front. The teeth are implanted in separate sockets, as in the crocodile, and there are from thirty to forty on each side the jaws. They are conical, slender, long, pointed, slightly recurved, and longitudinally grooved from the base upwards, having a long round fang. The pulp cavity is long and single, surrounded by a body of fine dentine, covered on the crown with a layer of enamel, and at the base with cement. The dentition in the plesiosauri differs from that of the crocodiles, in the successional teeth emerging through distinct apertures on the inner side of the sockets of their predecessors, and not through the pulp cavity. The vertebræ are relatively longer than in ichthyosaurus, and their articular faces are either flat, or slightly excavated towards the periphery, with a gentle convexity in the centre. The caudal vertebræ have two distinct hœmapophyses, not united into a chævron bone. The cervical ribs, or hatchet-bones, are attached by two articular facets to the bodies of the vertebræ, but with a very narrow space between them ; scarcely large enough for the passage of the sympathetic nerve, and apparently not sufficiently for the vertebral artery. The pectoral arch is remarkable for the pair of elongated and broad coracoid bones ; indeed, these bones attain their maximum developement in plesiosaurus. The ribs, which are very numerous, and extended throughout a great portion of the vertebral column, are connected anteriorly, in the abdominal region, by several slender bones, called costal arcs, consisting of six or seven pieces to each pair of ribs. The ichthyosaurus has a similar structure, but the arcs are composed of but five pieces. As these connecting bones are so constructed as to admit of a certain degree of gliding motion on each other, it is inferred that by this mechanism considerable expansion of the pulmonary cavities in these air-breathing marine reptiles was attained. The paddles are composed of fewer and more slender bones than in the ichthyosaurus, and must have been a more elegant form, and possessed greater flexibility. The wrist consists of a double row of round oscicles, which are succeeded by five elongated metacarpal, and these by numerous slender and slightly curved phalangeal bones.



* MEGALOSAURUS.

MEGALOSAURUS.—The most important relic of this great carnivorus terrestrial lizard is a portion of the right armur of the lower jaw, containing one perfect tooth and the germs of several teeth. The tooth of megalosaurus has a conical, laterally compressed crown, with the point recurved, like a sabre, and the edges trenchant and finely serrated. The implantation of the teeth is very peculiar, and exhibits the dentition of crocodilians blended with that of the lacertians. The form of the jaw shows that the head was terminated by a straight narrow snout, compressed laterally like that of the *delphinus gangeticus*.† The form of the teeth exhibits a combination of mechanical contrivances remarkable, and there is provision for a constant succession of new teeth to supply the loss of the old ones. For this

* Μεγας, great; σαυρος, lizard.

† NOTE.—We would direct attention to this history, as affording an illustration of mechanical contrivance for the good of the creature, and as also illustrative of the resources of the Great Designer, who, as in this case, invariably foreknows the wants of His creatures and provides for them.

purpose the new teeth are formed in distinct cavities by the side of the old ones, and towards the interior surface of the jaw; so that each as it grew gradually pushed away the one previously existing there, expelling it by the usual process of absorption, and insinuating itself into the cavity thus left vacant. When young and first protruding above the gum, the apex of the tooth presented a double cutting edge of cerrated enamel; but as it advanced in growth, its direction was turned backwards in the form of a pruning-knife, and the enamelled sawing edge was continued downwards to the base of the inner and cutting side, but became thicker on the other side, obtaining additional strength when it was no longer needed as a cutting instrument. The vertebræ indicate a more decided departure from the lacertian type than the mode of dentition; but by far the most remarkable difference occurs in the group of five of these bones, which, anchylosed together, form the sacrum, which are so characteristic of the land saurians. Up to the time that these bones were discovered, there had been no instance recorded of any reptilian animal possessing more than two saceral vertebræ; and when first the megalosaurian remains were described by Dr. Buckland, three of the five were referred to by him as belonging rather to the lumbar or caudal series. The whole five, however, properly belong to the sacrum, and they were so contrived as to give an amount of strength and resisting power that must have corresponded to enormous muscular energy and weight; and, as if to give them every possible advantage of position, they are not anchylosed in a straight line, but in a gentle curve, forming an arch, and therefore better able to support the weight pressing upon them. All the bones of the extremities are exceedingly large compared with the same parts in existing saurians; the cylindrical ones are hollow, like those of land animals. The thigh-bone and the tibia each measure nearly three feet in length; and thus the contour of the hinder part of the body, raised high above the ground, must have been totally unlike that of any existing crocodilian; and the large share in the support of the trunk assigned to the hinder legs of the megalosaurus, probably made it necessary in that genus, as in the heavy land quadrupeds, that a greater proportion of the spine should be permanently and solidly fastened together, in order to transfer the weight through the bones of the pelvis to the legs.

MEGATHERIUM.—Prof. Owen describes gigantic mammiferous quadrupeds of the following genera of a family extinct, and allied to the sloths:—Megalonyx —Μεγαλη, great; ονυξ, a claw. Scelidotherium—Εχελις, femur; θηριον, beast. Mylodon—Μυλη, mola; οδους, tooth. Glossotherium—Γλῶττα, tongue; θηριον, beast. Megatherium—Μεγα, great; θηριον, beast. They are fully described in "Darwin's Zoology of the Beagle;" one will suffice to shew the gigantic proportions of these extinct creatures, as compared with their representatives of this age. Megatherium was a great beast, its size exceeding that of existing edentata, to which it is most nearly allied, in a greater degree than any other fossil animal exceeds its living congeners. "With respect," says Mr. Owen, "to the question of the respective affinities of the megatherium to the bradypodoid or dasypodoid families, the result of the examination of the teeth speaks strongly for its closer relationship with the former group. The megalonyx, mylodon, and scelidotherium, in like manner correspond, in the structure of their teeth, with the sloth."


MEGATHERIUM.

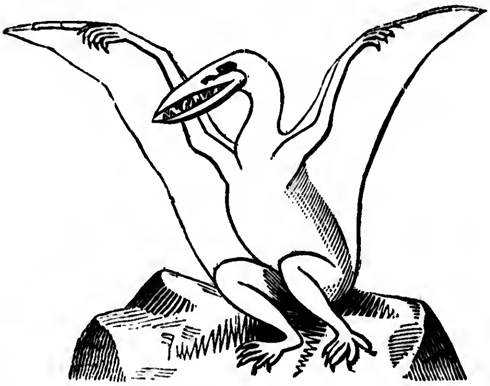
If, from a similarity of dental structure, we may predicate a similarity of food, it may reasonably be conjectured that the leaves and soft succulent sprouts of trees may have been the staple diet of the megatheroid quadrupeds, as of the existing sloths. Their enormous claws, I conclude, from the character of the powerful mechanism by which they were worked, to have been employed, not as in the sloths, to carry the animal to the food, but to bring the food within reach of the animal, by uprooting the trees on which it grew. In the remains of the megatherium, we have evidence of the framework of an animal equal to the task of undermining and hauling down the largest members of a tropical forest. In the latter operation it is obvious that the immediate application of the anterior extremities to the trunk of the tree, would demand a corresponding fulcrum, to be effectual, and it is the necessity for an adequate basis of support and resistance, to such an application of the fore extremities, which gives the explanation to the anomalous developement of the pelvis, tail, and hinder extremities in the megatheroid quadrupeds. No wonder, therefore, that the type of structure is so peculiar; for where shall we find quadrupeds equal, like them, to the habitual task of uprooting trees? We have, in bradypus tridactylus, a dwarfed representative of megatherium cuveri; yet the naturalist determines the relationship; and in all these there is the promise of the more perfect extension of the plan of creation. In order to illustrate the connexion, we give bradypus tridactylus—one of the sloths of South America—the living representative of the megatherium. They are deserving especial attention, as well from the singularity of their structure, and from the mistakes which have prevailed with regard to their habits, as from the relationship,

BRADYPUS TRIDACTYLUS.

in osteological details, to the megatherium.

The sloths are arranged by naturalists in a tribe termed *tardigrada*, from their feeble power of progression on the surface of the land; for the same reason they are called *paresseux* by the French, and *sloths* by the English. They are of slender form and small size: the largest species is but little larger than a cat. They have long toes, and nails which fold up, so as to enable the animal to walk in the same way as if our fingers were folded under the palm of the hands, but which are not capable of being retracted into a sheath, as in the feline tribes. The arms are double the length of the legs, and, from the construction of the limbs, the animal, when it walks, or rather crawls on the ground, is obliged to drag itself along on its elbows. But these creatures are destined to inhabit trees; their proper element is on the branches, and they can pass from bough to bough, and from tree to tree, with a rapidity which soon enables them to lose themselves in the depths of the forests. They live on the leaves and the young shoots, and, unless disturbed, never quit a tree until they have stripped off every leaf. To avoid the labour of a descent, they drop to the ground, previously coiling themselves into a round ball, in which state, while attached to the branch, they may be taken alive. Thus the habits and economy of the sloth point out the necessity for a peculiarity in the structure of its claws. The monkey leaps and swings himself from tree to tree, and catches at will the branches or the trunk; but the sloths do not grasp; their claws are mere hooks to hang by, and their great strength is in their arms. They never unfix one set of hooks until they have caught a secure hold with the other, thus hanging by their arms and legs, while their bodies are pendent; and they sleep in the same position. The bones of the arm are constructed to suit these conditions. The humerus has a long internal condyle for the origin of large muscles to move the enormous claws; and there is an opening for the passage of the principal nerves and blood-vessels, to protect them from the pressure to which they would be exposed from the powerful muscular action; and the radius (one of the bones of the fore-arm) is constructed to allow of a free rotary motion to the limb. In the extinct sloths a similar conformation is maintained, but somewhat modified to suit the different physical conditions under which they existed.

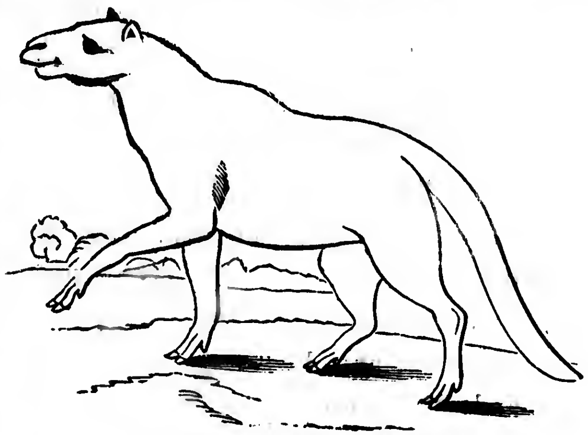
THE PTERODACTYLE.—Among the most remarkable disclosures made by the researches of geology, we may rank the flying reptiles under the genus pterodactyle—finger-winged—a genus presenting more singular combinations of form than we find in



PTERODACTYLE.

any other creatures yet discovered amid the ruins of the ancient earth. This extraordinary discordance of opinion respecting a creature whose skeleton was almost entire, arose from the presence of characters apparently belonging to each of the three classes to which it was referred—bird, bat, flying reptile. The form of its head and length of its neck resembled that of birds, its wings approaching to the proportion and form of those of bats, and the body and tail approximating to those of ordinary mammalia. These characters, connected with a small skull, as is usual among reptiles, and a beak furnished with no less than sixty pointed teeth, presented a combination of apparent anomalies, which it was reserved for the genius of Cuvier to reconcile. In this animal we have an extinct genus of the order saurians, in the class of reptiles, (a class that now moves *only* on land or in the water,) adapted by a peculiarity of structure to fly in the air.

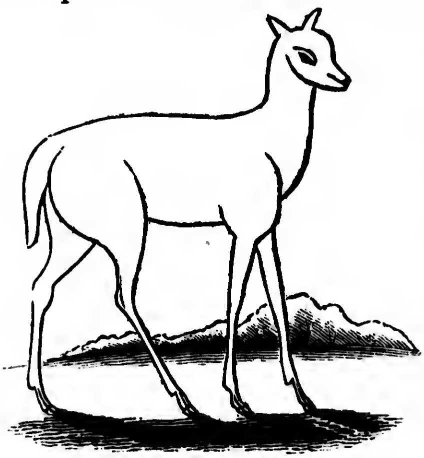
In external form, these animals somewhat resemble our modern bats and vampires; most of them had the nose elongated, like the snout of a crocodile, and armed with conical teeth. Their eyes were of enormous size, apparently enabling them to fly by night. From their wings projected fingers, terminated by long hooks, like the curved claw on the thumb of the bat. These must have formed a powerful paw, wherewith the animal was enabled to climb or suspend itself from trees. It is probable, also, that the pterodactyles had the power of swimming, which is so common in reptiles, and which is now possessed by pteropus pselaphon, or vampire bat of the island of Bonin. With flocks of such-like creatures flying in the air, and shoals of no less monstrous ichthyosauri and plesiosauri swarming in the ocean, and gigantic crocodiles and tortoises crawling on the shores of the primeval lakes and rivers—air, sea, and land must have been strangely tenanted in these early periods of our infant world. As the most obvious feature of these fossil reptiles is the presence of the organs of flight, it is natural to look for the peculiarities of the bird or bat in the structure of the component bones. All attempts, however, to identify them with birds, are stopped at once, by the fact of their having teeth in the beak, resembling those of reptiles. The form of a single bone—the os quadratum—enabled Cuvier to pronounce at once that the creature was a lizard; but a lizard possessing wings exists not in the present creation, while a moment's comparison of the head and teeth with those of bats, shews that the fossil animal in question cannot be referred to that family of flying mammalia. Another race of creatures, possessing a compound character, and now extinct, and represented by separate animals, has been ably described by Prof. Owen; and Hugh Miller, in speaking of the palæotheres, remarks, "the eocene ages were peculiarly the ages of the palæotheres, strange animals of that pachydermatous or thick-skinned order to which the elephants, the tapirs, the hogs and the horses belong. It had been



* ANOPLOTHERIUM COMMUNE.

* ανοπλος, unarmed; θηριον, beast.

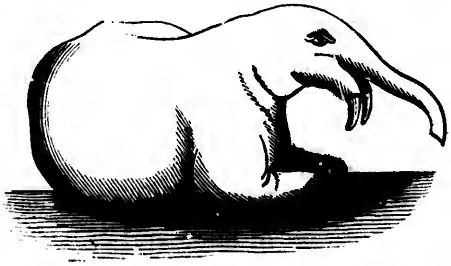
remarked by naturalists, that there are fewer families of this order in living nature than almost any other; and that, of the existing genera, not a few are widely separated in their analogies from the others. But in the palæotheres of the eocene, which ranged in size from a horse to a hare, not a few of the missing links have been found—links connecting the tapirs to the hogs, and the hogs to the palæotheres proper; and there is at least *one species suggestive* of an union of some of the more peculiar traits of the tapirs and the horses. And Prof. Owen describes anoplotherium commune as being one of the earliest forms of hoofed quadrupeds introduced upon the surface of the earth; and it is most important, in reference to the origin of organised species, to bear in mind that this ancient herbivore presents in comparison with living species, no indications of an inferior or rudimentary character in any known part of its organisation; and that, with regard to its dentition, it not only possessed incisors and canines in both



ANOPLOTHERIUM GRACILE.

jaws, but that those teeth were so equably developed, that they formed one unbroken series with the premolars and true molars, which character is now manifested only in the human species. Amongst the varied forms of existing herbivora, we find certain teeth disproportionally developed, sometimes to a monstrous size; whilst other teeth are reduced to rudimental minuteness, or are wanting altogether; but the number of teeth in any hoofed quadruped never exceeds *that displayed in the dental formula* of anoplotherium. It is likewise most interesting to find, that those species with a comparatively defective dentition, as the horned ruminants for example, manifest transitorily, in the *embryo state*, the germs of upper incisors and canines, which disappear before birth, but which were retained and functionally developed in the cloven-footed anoplothere. The dental system of this extinct quadruped realised, in short, that ideally perfect type upon which so ma· kinds and degrees of variation have been super·.. duced in the dentition of later and still-existing s.. cies of hoofed mammalia.

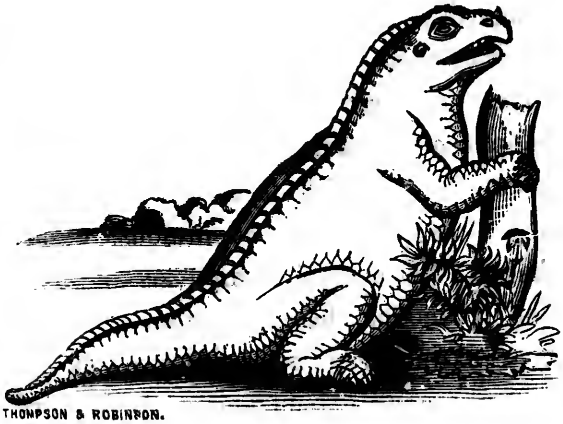
The dinotherium, one of the greatest quadrupedal animals that ever lived, seems to have formed a connecting link, in the middle or miocene tertiary, between the pachydermata and cetaceæ. In 1836, an entire head of this animal was discovered at Eppleshem, measuring about four feet in length, and three in breadth. Prof. Kaup states that the very remarkable form and disposition of the hinder part of the skull, shew it to have been connected with muscles of extraordinary power, to give that kind of movement to the head which would admit of the peculiar action of the tusks in digging into and tearing up the earth. They further observe that Dr. Buckland's conjectures were true respecting the aquatic habits of this animal, by approximations in the form of the occepital bone to the occeput of cetaceæ; the dinotherium, in this structure, affording a new and important link between the cetaceæ and pachydermata. Each camus of the lower jaw, which, in the larger specimens, are fully four feet in length, bore at the symphysis a great bent tusk turned



DINOTHERIUM.

downwards, which appears to have been employed as a pick-axe, in uprooting the aquatic plants and liliaceous roots on which the creature seems to have lived. The head, which measured about three feet across, was provided with muscles of enormous strength, arranged so as to give potent effect to the operations of this strange tool. The hinder part of the skull not a little resembled that of the cetaceæ, while, from the form of the nasal bones, the creature was evidently furnished with a trunk like the elephant.

Thus, another combination is observed among animals, when a series exhibits such a succession as exemplifies a natural gradation, without immediate or necessary reference to either embryonic developement or succession in time, as the chambered cephalopods. Such types may be called *progressive* types.



* IGUANODON.

Iguanodon.—The remains of this creature, so carefully collected and treasured by Dr. Mantell, are now preserved in the British museum.

In instituting a comparison between the maxillary organs of the iguanodon and those of the existing herbivorous lizards, we are at once struck with their

* *Iguana*, a saurian reptile; and ὀδοὺς, a tooth.

remarkable deviation from known types of the class reptilia. In the amblyrhynchi, the most exclusively vegetable feeders of the saurian order, the alveolar process, beset with teeth, is continued round the front of the mouth ; the junction of the two rami of the lower jaw, at the symphysis, presenting no edentulous interval whatever, and the lips not being more produced than in other reptiles ; for these creatures chip off and bruise their food, and cannot grind or masticate it: in the ignuanas the same character exists. In the carnivorous saurians, the teeth are also continued to symphysal suture, on each side. The extinct colossal lizards offer no exception to this rule : in the acrodont* mosasaurus of the chalk, in the thecodont megalosaurus of the oolite and wealden, the jaws are armed with teeth round the anterior extremity. In short, the edentulous, expanded, scoop-shaped, procumbent symphysis of the lower jaw of the iguanodon, has no parallel among either existing or extinct reptiles ; and we seek in vain for analogous organs, except among the herbivorous mammalia. The nearest approach is to be found in some edentata,† as the two-toed sloth, in which the lower part of anterior jaw is edentulous and much prolonged. The mechanism of the maxillary organs

* **Acrodont.—Those lizards with the teeth fixed to upper margin or ridge of jaw-bone. Pleurodonts.—Those in which the teeth are anchylosed to side of dentary bone. Thecodonts.—Having the teeth implanted either loosely, or anchylosed to walls of sockets. Lacertians.—They are said to be pleodont, solid toothed; or cœlodont, hollow toothed.**

† **Edentata: *ex*, without; *dens*, a tooth.**

is in perfect harmony with the remarkable characters which rendered the first known teeth enigmatical; and in the Wealden herbivorous reptile we have a solution of the problem, how the integrity of the type of organisation, peculiar to the class of cold-blooded vertebrata, was maintained, and yet adapted, by simple modifications, to fulfil the conditions required by the economy of a gigantic terrestrial reptile, destined to obtain support exclusively from vegetable substances, in like manner as the extinct colossal herbivorous edentata, which flourished in South America, ages after the country of the iguanodon had been swept off the face of the earth. In fine, we have in the iguanodon the type of the terrestrial herbivora, which, in the remote epoch termed "Age of Reptiles," occupied the same relative position in the scale of being, and fulfilled the same general purposes as the mastodons, mammoths, and mylodons of the tertiary and existing pachyderms.

In the present state of our knowledge we may, however, safely infer, that the body of the iguanodon was equal in magnitude to that of the elephant, and as massive in its proportions; for, being a vegetable feeder, a large developement of the abdominal region may be inferred. Its limbs must have been of a proportionate size to sustain so enormous a bulk; one of the thigh-bones, (in the British Museum,) if covered with muscles and integuments of suitable proportions, would form a limb seven feet in circumference. The hinder extremeties, in all probability, presented the unwieldy contour of those of the hippopotamus or rhinoceros, and were supported by very strong short feet, the toes of which were armed with claws like those of certain turtles. The fore-legs appear to have been less bulky, and were furnished with hooked claws resembling the ungual phalanges of the iguana. The teeth demonstrate the nature of the food required for the support of this herbivorous reptile, and the power of mastication it enjoyed; and the ferns, cycadeous plants, and coniferous trees with which its remains are associated indicate the flora adapted for its sustenance. But the physiognomy of this creature, from the peculiar modification of the skull and jaws required for the attachment and support of the powerful muscles necessary for the trituration of tough vegetable substances, must have differed considerably from that of all known saurians.

Again, a distinction ought to be made between prophetic types proper, and what may be called *synthetic* types, though both are more or less blended in nature. Prophetic types proper are those which, in their structural complications, lean towards *other combinations* fully realised in a later period; while synthetic types are those which combine in a well-balanced measure features of *several* types, occurring as distinct, only at a later time. Sauroid fishes and ichthyosauri are more distinctly synthetic than prophetic types, while pterodactyles have more the character of prophetic types; so are also echinocrinus with reference to echini, pentremites with reference to asteroids, and pentacrinus with reference to comatula.

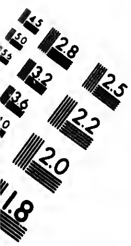
These facts, from the unerring pages of the book of nature, are conclusive as to the order and arrangement which have been observed in the great plan of progressive world developement; to render the evidence complete, we shall now shew that the conditions of the earth have been repeatedly varied, and its climate and other physical qualities changed to meet the peculiar introduction and limitation of life forms. While it is undoubtedly true that the animal or vegetable type cannot be *transformed* by any external conditions, it is no less true that certain organised beings are adapted to, and live best or only in certain geographical limits; and it would appear that, as the plan of creation became more and more unfolded, the restriction of certain forms to certain areas was manifestly established as a law; and this is even sometimes found to be so, although there may be no apparent climatal causes discoverable, adequate to account for the distribution of life in each case. Let us see if these assertions cannot be clearly established.

The anoplotherium already referred to furnishes an instance of general diffusion, having extended far into Asia, where its remains have been found associated with forms now peculiarly Asiatic. Dr. Falconer has described, in vol. iv., part ii., Geo. Soc. Proceedings, some fossil remains of anoplotherium and giraffe from the Sewalik Hills, in the north of India, on which he remarks: "That the bones are found imbedded either in clay or in sandstone. The bones described were found in the former, and designated as 'soft fossil:' the giraffe in 'the hard fossil.'" The remarkable admixture of extinct and recent forms which constitute the ancient fauna has been noticed by Messrs. Falconer. An extinct testudinate form, (*colossochelys atlas*,) as enormous to other known chelonians as the saurians of the lias oolite are to their existing analogue, is there associated with one or more of the same species of crocodile that now inhabit the rivers of India. The evidence respecting one of the species of crocodile, resting as it does on numerous remains of individuals of all ages, is considered by the authors as nearly conclusive of the identity of the fossil with its recent analogue. These reptiles occur together with extinct species of such very modern types as the monkey, the camel, the antelope, and (as has been shewn) the giraffe; and these are met by species of the extinct genera liratherium and anoplotherium. As regards the anoplotheriæ, those hitherto discovered have been confined to Europe, and as regards their geological distribution, to the older and middle tertiaries. In India this genera continued down to the period when existing Indian crocodiles, and probably some other recent forms, had become inhabitants of that region. It is also worthy of notice that the moschus aquaticus of Ogilby has its metacarpals distinct along its whole length: its fore-leg, from the carpus downwards, is undistinguishable from that of the peccary; and its succentional toes are as much developed as in the last mentioned animal, thus possessing the supposed distinctive characters of the anoplotherium pachyderms. The deviation from the ordinary ruminant type, indicated by the foot of this moschus, is borne out by a series of modifications in the construction of the head, and in the bones of the extremeties and trunk, all tending in the direction of the pachyderms.

The finding of the giraffe as a fossil furnishes another link to the rapidly increasing chain which will sooner or later connect the extinct with existing forms in a continuous series. The bovine, antelope, and antlered ruminants have numerous representatives, both recent and fossil. The camel tribe comprises a considerable fossil group, represented in India by the camelus siraleusis, and is closely approached to in America by the extinct pachydermatous maccrauchenia (pataghonica). The giraffe has hitherto been confined to a single species, and has occupied an isolated position in the order to which it belongs. It is now as closely represented by its fossil analogues as the camel.

The giraffe *shews a new light on the original physical characters* of northern India ; for whatever may be urged in regard to the possible range of its vegetable food, it is very clear that like the existing species, it must have inhabited an open country, and *had broad plains to roam over.* In a densely forest-clad tract like that which *now* skirts the foot of the Himalayas, it would soon have been exterminated by the large feline feræ, by the hyænas and large predaceous bears which are known to have been members of the old Sewalik fauna.

We desire, in analysing these several facts, to shew that they do not warrant the assertion of Mr. Miller, and those who abandon the Mosaic history on evidence which they would consider insufficient in any other case. In language which does infinite honour both to their hearts and heads, Messrs. Owen and Agassiz have clearly brought out that most glorious law in natural history, which completely establishes what the latter philosopher has rightly named—the prophetic constitution of animals—a law which plainly declares the object of creation, as well as the unity of design. We clearly see that in each succeeding epoch, as the great plan became more and more pronounced, the animals and plants became more and more closely related, as well as more largely particularised. In a paper by Mr. A. R. Wallace, in the Mag. Nat. Hist., vol. 20, No. 121, A.D., 1858, we have a clear enunciation of this law, as well as a fair illustration of the very equivocal mode of writing adopted by those who, while professing to hold the doctrine of epochal creations, at the same time write as if they recognised either the validity of the theory of La Marc or some thing which approaches it very closely. "We know," observes Mr. Adams, "that at a comparatively recent geological period *not one single* species of the present organic world was in existence, while all the vertebrata now existing have had their origin still more recently. How do we account for the places where they came into existence? Why are not the same species found in the same climates all over the world? The general explanation given is, that as the ancient species became extinct, new ones were created in each country and district, adapted to the physical conditions of that district." Sir C. Lyell, who has written with more ability on this subject than most naturalists, adopts this view. He illustrates it by speculating on the vast physical changes that might be effected in North America by the upheaval of a chain of mountains in the Sahara. "Then," he says, "the animals and plants of northern Africa would disappear, and *the region would gradually become fitted for the reception of a population of species perfectly dissimilar in their forms, habits and organisation.*" This theory implies that we shall find a general similarity in the production of countries which resemble each other in character and general aspect, while there shall be a complete dissimilarity between those which are totally opposed in these respects. And if this is the general law which has determined the distribution of the existing organic world, there must be no exceptions, no striking contradictions. Now, we know how totally the productions of New Guinea differ from those of the western islands of the eastern archipelago, say Borneo, as the type of the rest, and as almost equal in area to New Guinea. This difference, it must be well remembered, is not one of species, but of genera, families and whole orders. Yet it would be difficult to point out two countries more exactly resembling each other in climate and physical features. In neither is there any marked dry season, rain falling more or less all the year round; both are near the equator, both subject to the east and west monsoons, both everywhere covered with lofty forests, both have a great extent of flat swampy coast, and a mountainous interior, both are rich in palms and pandanaceæ. If, on the other hand, we compare Australia with New Guinea, we can scarcely find a stronger contrast than in their physical conditions: the one near the equator, the other near and beyond the tropics; the one enjoying perpetual moisture, the other with alternations of excessive drought; the one a vast verdant forest, the other dry open woods, downs or deserts. Yet the fauna of the two, though mostly distinct in species, are strikingly similar in character. Every family of birds (except menuridæ) found in Australia, also inhabits New Guinea, while all those striking deficiencies of the latter exist equally in the former. But a considerable proportion of the characteristic Australian genera are also found in N[illegible] Guinea ; and, when that country is better known [illegible] to be supposed that the number will be in[illegible] In the mammalia it is the same. Marsupials [illegible] almost the only quadrupeds in the one as in the other. If kangaroos are especially adapted to the dry plains and open woods of Australia, there must be some other reason for their introduction into the dense damp forests of New Guinea ; and we can hardly imagine that the great variety of monkeys, of squirrels, of insectivora, and of felidæ were created in Borneo, because the country was adapted to them, and not one single species given to. another country exactly similar, and at no great distance. If there is any reason in the hardness of the woods, or the scarcity of wood-boring insects, why wood-peckers should be absent from Australia, there is none why they should not swarm in the forests of New Guinea, as well as in those of Borneo and Malacca. We can hardly help concluding, therefore, that some other law has governed the distribution of existing species, than the physical condition of the countries in which they are found ; or we should not see countries most opposite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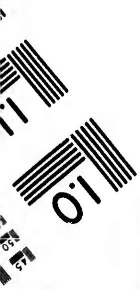
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in character with similar productions, while others almost exactly alike, as respects climate and general aspect, yet differ totally in their forms of organic life. The simple law of every new creation being closely allied to some species already existing in the same country, would explain all these anomalies, if taken in conjunction with the changes of surface and the gradual extinction and introduction of species, which are facts proved by geology. At the period when New Guinea and North Australia were united, it is probable that their physical features and climate were more similar, and that a considerable portion of the species inhabiting each portion of the country were found over the whole. After the separation took place, we can easily understand how the climate of both may be considerably modified, and this might perhaps lead to the extinction of certain species. During the period that has since elapsed, new species have been gradually (?) introduced into each, but in each closely allied to pre-existing species, many of which were at first common to the two countries. This process would evidently produce the present condition of the two faunas, in which there are many allied species—few identical. The great well-marked groups absent from the one, would necessarily be so from the other also; for however much they may be *adapted* to the country, the law of close affinity would not allow of their appearance, except by a long succession of steps, occupying an immense geological interval. The species which, at the time of separation, were found only in one country, would, by the gradual introduction of species allied to them, give rise to groups peculiar to that country. This separation of New Guinea from Australia no doubt took place whilst Ara was part of the former island. Its separation must have occurred at a very *recent period*, the number of species common to the two shewing that scarcely any extinctions have since taken place, and probably as few introductions of new species. Both Prof. Owen and Mr. H. Miller enunciate, with considerable force, the existence of such a law as that referred to by Mr. Wallace, although it will not be difficult to shew that the former philosopher does not in the least lead us to suppose that "the gradual introduction of species" is a necessary condition of that law. In his observations on the Australian fauna, Prof. Owen clearly proves, from the evidence afforded by its fossil remains, that there was a close affinity between its extinct fauna and its present indigenous races; he says, "The close approximation of the *phascolotherium* to marsupial genera, now confined to New South Wales and Van Dieman's Land, leads us to reflect upon the interesting correspondence between other organic remains of the British oolite, and other existing forms *now* confined to the Australian continent and adjoining seas. Here, for example, swims the cestracion or Port

Jackson shark, which has given the key to the nature of the palates from our oolite, now recognised as the teeth of the congeneric forms of cartilaginous fish." Mr. Brodrip observes that a recent species of trigonia (three-corners) has very lately been discovered on the coast of Australia—that land of marsupial animals. Our English specimen lies imbedded with a number of fossil shells of that genus. Not only trigonia, but living terebratulæ (*terebratus*, pierced) exist, and the latter abundantly in the Australian seas, yielding food to the cestracion, as their extinct analogues doubtless did to the allied cartilaginous fish called acrodi, psammodi, &c. Araucariæ (Norfolk Island pine) and cycadeous plants, likewise flourish on the Australian continent, where marsupial animals abound, and thus appear to complete a picture of an ancient condition of the earth's surface, which has been superceded in our hemisphere by other strata and [illegible]gher type of mammalian organisation. "It has been," observes Hugh Miller, "repeatedly remarked that the existing plants and trees of the United States, with not a few of its fishes and reptiles, bear in their forms and construction the marks of a much higher antiquity than those of Europe. The geologist who sets himself to discover similar types on the eastern side of the Atlantic, would have to seek for them among the deposits of the later tertiaries. North America seems to be passing through its later tertiary ages,

(?) and it appears to be a consequence of this curious transposition, that while in Europe the mastodonic period is removed by two great geologic periods from the present time, it is removed from it in America by only one. Even in America, however, that period lies far beyond the reach of human tradition. "It is a circumstance quite extraordinary and unexpected," says Agassiz, in his profound work on lake Superior, "that the fossil plants of the tertiary beds of Oeningen resemble more closely the trees and shrubs which grow *at present* in the eastern parts of North America, than those of any other parts of the world; thus allowing us to express correctly the difference between the opposite coasts of Europe and America, by saying that the present eastern American flora, and we may add the fauna also, *have a more* ancient character than those of Europe. The plants and trees growing in our days in the United States are, as it were, old-fashioned; and the characteristic genera lagomys, (lagomys pusillius, or calling hare,) chelydea, (turtle family,) and large salamanders with permanent gills, that remind us of the fossils of Oeningen, are at least equally so: they bear the marks of former ages." Again, as already stated, Mr. Darwin, in his account of the fossil remains found in the Pampas, South America, remarks: "The most remarkable of the fossil bones discovered in the Pampas belong to several extinct colossal animals of the edentata, an order of which the armadillos, sloths, and ant-eaters are the living representatives. But as the extinct forms differ greatly from the existing ones in their gigantic proportions—short massive extremities and thick and short tail—their *mode* of life must have been very dissimilar.

We have here, then, evidence that while the South American fauna was determined at this remote period, as was the case with the localisation of the previously more widely-diffused marsupalia in Australia, and as is the case with the fauna and flora of North America, yet the animals are not the progenitors of the present race. We shall now enquire whether the mastodon (μαστος, a teat, οδον, a tooth) does not likewise furnish proof of its having had an extensive range, both in time and space, not as a consecutive race, but as new genera introduced at special times. Dr. Falconer has very recently investigated the history of these fossils, and, as the result of his remarks, declares: "That it is most important to geology, that every mammal found in the fossil state should be defined as regards, first, its *specific* distinctness, and, secondly, *its range of existence geographically and in time*, with as much severe exactitude as the available materials and the state of our knowledge will admit." He observes that, "with regard to the remains of the proboscidian genera—dinotherium, mastodon, and elephant—some of which abounded in the miocene (μειον, less, χαινος, recent) and pliocene (πλειον, more, χαινος, recent) deposits of Europe, Asia, and America, the opinions respecting the species and their nomenclature in all the standard palæontological works on the subject, are extremely confused, and often contradictory." Dr. Falconer proceeds to state, that the remains of only one species of mastodon have hitherto been discovered in the British Isles. They occur in what is called the older pliocene red crag, at Felixstowe and Sutton in Suffolk, and in the newer pliocene—fluvio-marine or mammaliferous crag—at various localities near Norwich in Suffolk. He describes the characteristic peculiarities both of the molars (teeth) and of the symphysis of the lower jaws in the three species; and shews that the molars from the crag mastodon were like those of *tetralophidon avernensis*, characterised by four-ridged molars, with their conical points more or less alternating, and with their valleys blocked up; and that they essentially differed from the molars of the *trilophodon augustidens* from Summore, Dax, &c., and from *tetralophodon longirostris* of Eppleshem. The mastodon avernensis of Montpellier, Auvergne, Italy, &c., had no lower tusks; and Dr. Falconer is of opinion that the only specimen which has been figured and described as one of the lower tusks of the crag mastodon, is a terminal fragment of one of the upper tusks of that species. From osteological considerations, it appears that *tetralophodon avernensis* was of a low heavy make; that *tetralophodon* *longirostris* was of similar general proportions ; and that *trilophodon augustidens* was higher in its limbs, and of a comparatively light and slender shape. In his remarks on the geological age, and associated faunas of the formations in which each of these species severally occur, Dr. Falconer has noticed that trilophodon augustidens is a *characteristic species* of the miocene falunian beds throughout Europe, and is associated with *trilophodon tapiroides* in the faluns (middle tertiary) of France, and the upper freshwater molasse of Switzerland. The *tetralophodon avernensis* is characteristic of the *pliocene* fauna, and it had a very extended range over Europe, accompanying loxodon (nesti) in Tuscany ; trilophodon, borsoni, loxodon priscus, and elephas antiquus in Piedmont and Lombardy ; loxodon meridionalis at Montpellier ; and trilophodon borsoni, loxodon meridionalis, and loxodon priscus in Velay and Auvergne. Dr. Falconer concludes that,--1st. The mastodon remains which have been met with in the fluvio-marine crags, *belong to a pliocene form*, named tetralophodon avernensis. 2ndly. That the mammalian fauna of the red and fluvio-marine crags, regarded as a whole, bears *all the characters* of a pliocene age, and is identical with the sub-Appenine pliocene fauna of Italy. 3rdly. The red and fluvio-marine crags, tested by their mammalian fauna, must be considered as a bed of the same age. Considering these observations, so recently made by Dr.

Falconer, of the highest importance, we shall now enquire into the extent of the operation of two laws which are supposed, and we believe truly, to have governed the operation of creative energy in past ages :—

1. Different sets of tertiary strata immediately superimposed on each other, contain distinct imbedded species of fossils, in consequence of fluctuations which have been going on in the animate creation, and by which, in the course of ages, one state of things in the organic world *has been substituted* for another *wholly dissimilar.*

2. *In proportion as the age of a tertiary deposit is more modern, so is its fauna more analogous to that now in being in the neighbouring seas*; and that the present distribution of organic *forms* dates back to a period anterior to the creation of existing species: in other words, the limitation of particular genera or families of quadrupeds, mollusca, &c., to certain existing provinces of land and sea, *began* before the species now contemporary with man had been introduced upon the earth.

A very few remarks will suffice to illustrate the general reception of the first law above quoted. We may call to mind the opinion of M. Agassiz, already expressed: "One result, however, stands now unquestioned,—the existence, during each great geological era, of an assemblage of animals and plants differing essentially from each period. And, by period, is meant those minor sub-divisions, in the successive sets of beds of rocks, which constitute the stratified crust of our globe, the number of which is daily increasing, as our investigations become more extensive and more precise ; and that this seems to be a universal fact in geology, would appear from all authors accepting it as a law; and, as stated by the latest writers, may be received. Thus, in speaking of the upper silurian age, Mr. Jukes adds, "Of the life of the period, the plants are as little known to us as those of the preceding period. The animals include fish, *in addition* to those classes mentioned in the preceding period. Of the species, some range throughout all, others through two or three groups of the series ; while others, again, are confined to one particular group of beds, of which they are accordingly characteristic. A few species extend from lower into upper silurian rocks, and still fewer, *coming into existence* during this period, extend into the next or Devonian. These long successive species mostly ranged through great depths of water, and spread over large areas." So much, then, for the great fact which is admitted by all, that there have been at various particular periods, distinct and *new* acts of Creative Power.

The second law referred to, requires a more lengthened notice, and it is exceedingly important to discover, if possible, its true import, as we believe that, on a faithful interpretation of it depends our being able or unable to support the Mosaic record of the re-arrangement of the quaternary or human period.

We have already pointed out the admission, freely made by all modern naturalists, that the universe, in its organic kingdom, is constructed on one great and uniform *plan;* and that while there is reason to suppose that the foundation-stones of the whole scheme were laid at a very early period, yet different portions of the scheme have been projected variously, so that it is quite true that as it rose towards completion, its respective points of beauty and harmony were *progressively* unfolded. Thus, Sir R. Murchison remarks: "At the close of the permian era, an infinitely greater change took place in life, than that which marked the ascent from the silurian system to over-lying groups. The earlier races then disappeared, (at least all the species,) and *were replaced* by an entirely new creation, *the generic types* of which were *continued* through those long epochs which geologists term secondary or mesozoic—the mediæval age of extinct beings." In these, again, we learn, by consulting the works of many writers, how one formation followed another, each characterised by different creatures; many of them, however, exhibiting near their downward and upward limits, certain fossils which link on one reign of life to another. The first fiat of creation which went forth, doubtless ensured the perfect adaptation of animals to the surrounding media; and thus, whilst the geologist recognises a beginning, he can see in the innumerable facets of the eyes of the earliest crustacean, the same evidence of Omniscience as in the contemplation of the vertebrate form. Yet, however they admit the facts, some speculative minds think they can so explain them as not to justify the inference of progressive creations. They suppose that nearly all the strata of date antecedent to those in which the first signs of life have been detected, are often in so crystalline a state, that if they originally contained the remains of animals, the traces of them must have been obliterated by changes since effected in the structure of the rock. The hypothesis has been set aside by the fact of the existence of deposits many thousand feet thick, and scarcely at all altered, which, made up of sand, mud, and pebbles, constitute the very foundation of the fossil-bearing strata. In these huge lower sediments a zoophyte only has been detected; but immediately above them, in various and distinct countries, we perceive the oldest known small group of animals. When the explorer of the older formations produces his specimens of fossils from various parts of the world, to shew that the mass of the silurian rocks contains all classes of marine life with the exception of the fishes; his antagonist might reply, that gelatinous fishes, void of backbones, (like the solitary little amphioxus now living,) *may* have been the only creatures of their class which swarmed in the broad seas then prevailing: and if so, that no trace of them could exist, their boneless bodies perishing, and leaving no sign of their former existence. As an old student of nature's works, I cannot allow this bare probability to be placed in opposition to the very numerous and well recorded facts, which announce the *perfection* of all the other classes of the ancient sub-marine kingdom. If thousands of animals have left their coverings behind, is it rational to suppose that *every form* of the great class of fishes should be wanting in that frame-work, which, whether consisting of dermal plates, or of bony vertebræ, characterises them in the strata of all succeeding epochs? Nay, more, we see that in this same long period, in which no traces of fishes appear, there specially prevailed a superabundance of cephalopods; and as creatures of that structure are well known to be carnivorous, little doubt can be entertained that they acted the part of fishes, and were the scavengers of the silurian seas.

Another hypothesis, advanced in opposition to the mass of positive evidence, is, that although such earlier rocks are void of ichthyolites, the sediments *may* have all been formed in limited zones around the earth. But here, again, the application of such a theory is still more negatived by the facts adduced. Silurian rocks, similar in structure, and containing the same organic remains, are not confined to any one segment of the earth's surface, however broad, but are largely developed in nearly all known regions. The argument is therefore untenable in face of the knowledge we have acquired, that amidst the profusion of all other forms of aquatic life, fishes only are absent from strata of this early age. This prevalence of a widely-spread, primeval ocean, and of a surface which had not yet been subjected to those innumerable variations of outline which have since changed and modified the different climates of the earth, when connected with the belief in the former radiation of heat from its interior, are the chief data required to satisfy us that physical conditions then prevailed, with which the mature and extensive spread of the earlier groups of animals are in harmony. Again, if the old continents and islands, which existed during the accumulation of the marine silurian deposits, had borne larger trees, the numerous researches of geologists in all quarters of the globe must have brought to light some of them. For whilst we know that there are rocks of considerable extent, which, from the fine nature of their materials, may probably have been deposited in an ocean at some distance from a shore; there are also many silurian districts of the old and new world, where the form and structure of the deposit bespeak the action of wave and surge, and where the imbedded sea-weeds, zoophytes, and other remains, compel us to adopt the same view. If the primeval fauna does afford fewer spiral univalve shells than are seen among the animals of the carnivarian zones of our modern seas, we may suggest that shore lines, as we understand them, must have been much less numerous in primeval epochs than at the present day, now that the surface has been diversified by lofty dividing ridges on the land, and corresponding depressions in the ocean. In the fundamental facts disclosed, we cannot but recognise arrangements which, though perfect as respected all truly primeval creatures and plants, *were essentially different* from those of our own time. For if the then existing continents or islands had borne trees, some fragments of them must have been transported into adjacent estuaries, and mixed in the mud and sand, like the vegetables of every subsequent epoch, by the agency of those great streams, of whose mechanical power we have such decisive proof. In all quarters of the globe the silurian strata constantly lie in juxtaposition to the other overlying palaozoic formations; and hence it is impossible to apply to the lowest strata any reason which does not equally refer to those which repose upon them. For as the silurian rocks are constantly found in the same latitudes and longitudes as the Devonian and carboniferous, why is it that in one there are never found traces of vertebrata and land plants, and that in the other remains of both these classes abound in the other? By no theoretical suggestion, therefore, can the fair inference be evaded, *that things which did not exist during* the silurian period, *were created* in the very same tracts during the following ages. The uniformitarian who would explain every natural event in the *earliest periods*, by reference to the existing conditions of being, is thus stopped at the very threshold of the palace of former life, which he cannot deprive of its true foundations. Nature herself tells him, through her most ancient monuments, that though she has worked during all ages on the same *general* principles of destruction and renovation of the surface, there was formerly a distribution of land, in reference to the sea, very different in outline from that which now prevails. *That primeval state was followed by outbursts of great volumes* of igneous matter from the interior, the extraordinary violence of which is made manifest by clear evidences. Fractures in the crust of the earth, accompanied by oscillations that suddenly displaced masses *to thousands of feet* above or beneath their previous levels, were necessarily productive of such translations of water as to abrade and destroy solid materials, to an extent infinitely surpassing any change of which the historical era affords an example. We would cite the works of Leopold Von Buch, Elie de Beaumont, Sedgwick Strider, and numerous other geologists for countless proofs of this grander intensity of former geological causation, by which gigantic masses were inverted, and strata forming mountains have been so wrenched, broken, and twisted as to pass under the very rocks out of whose material they were constructed. In the Alps and other mountain chains we see signs of such former catastrophes, each of which resulted from convulsions utterly immeasurable and inexplicable by any reference to those puny oscillations of the earth which can be appealed to during the times of history.*

On what data, concludes Sir Robert Murchison, is founded the beautiful and rational theory of Lyell, which explains the successive changes of the climate of the earth? Is it not mainly dependent on those diversified evolutions proceeding from beneath the surface, which have caused changes in the former outline of former lands and seas, equivalent in extent, although different in position, to our present continents and oceans? And if such varied distribution of earth and water as the present had existed in the pristine periods, how could the same groups of animals, manifestly requiring the same conditions, the same temperature, and the same food, have had an almost universal diffusion.

Patient researches have demonstrated that in the primeval eras all living things differed completely from those of our own times; so we see how the animals subsequently created were adapted to new and altered physical conditions. Proceeding onwards from the early period in which we can trace

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* See Appendix 2, Murchison.

no sign of land plants or vertebrata, and in which the solid materials, enclosing every where a similar fauna, were spread out with great uniformity, we soon begin to perceive proofs of powerful evolutions, chiefly commencing *after* the coal formations, by which the earth's surface was so corrugated, that, after many perturbations, ***the groups of animals and plants were infinitely more restricted than before*** to given regions and climates. And as the highly diversified conditions of the latest geological era and of the present day were wholly unknown in the primeval epochs, so it follows that we should greatly err if we endeavoured to *force* all nature into a close comparison with existing operations.

Now, assured that these most important deductions are based on truth, and may be readily supported by valid arguments from the laws which govern the organic world, we ought then to find that, as the architect developed the several parts of his scheme, there would necessarily be a more and more close similarity in its parts, a greater harmony in the great whole. Such we find really to be the case in nature, and we cannot then but expect to find a greater and more close similarity between later creations. We shall therefore endeavour to shew that the re-creation of genera or varieties rather, of organic forms, has been and is the law of creation. We have already shewn, on the authority of Professor Owen and others, that the

Australian province had its marsupalia and South America its gigantic sloths ere the present analogous fauna were ushered in; and it is conclusively established that this condition of things does not result from any lineal descent, but is purely the effect of creative energy. We may here, then, without any violence to truth, declare that there is strong evidence of the restoration of extinct types, with some peculiar adaptations it may be to present conditions. Now if we believe and are satisfied that every modification and change which the universe has passed through has been effected designedly, and that there has clearly been a series of adjustments between the inorganic and organic kingdoms; then it must be admitted that the changes which the crust of the earth has undergone always and every where, had reference to the life forms which were to be its occupants. So we discover the constant improvement, the more evident unfolding of the great scroll of life, leading to the logical conclusion that they were made to subserve an end, and that the Originator of the whole is worthy to be praised, and intended that the works of his hands should set forth his glory and power. We have as yet seen no ground for believing or even entertaining the opinion that the various revolutions and evolutions, through which the world has passed, have been brought about solely by forces, which have been implanted in matter; on the contrary, while we have reason to admit that the various forms of matter result from many essences originally created, we cannot find proof of the reality of any *one* supreme, intelligent physical force, to which has been entrusted the governance and direction of matter. After we have, as it were, in thought dissected a material form, where do we necessarily lean the many reals of which it may be composed? We are, by the very constitution of our reason, forced to lean them as it were against the stronger will, and power, of one sole and efficient All-wise, Omnipotent, Intelligent Cause. We cannot acquiesce in the dogma sung by Virgil:—

> Principio, cœlum, ac terras, camposque liquentes,
> Lucentemque globum Lunæ, Titaniaque astra,
> Spiritus intus alit; totamque infusa per artus,
> Mens agitat molern, et magno se corpore miscet.
> Inde hominum pecudumque genus, vitæque volantum,
> Et que marmoreo fert monstra sub æquore pontus.

Yet such is the doctrine held by not a few in the present day, who, either openly or by implication, teach the dogma "that the material universe is governed and guided by an in-dwelling, intelligent power, an archæus or soul, rather than directed or re-arranged by the eternal Word, an Omnipotent, Omniscient, and Omnipresent Being. We believe that the evidence already adduced, is sufficient to establish the truth and validity of the latter conclusion, to which the very works of creation direct us; and if the principle of interference be established, if it has been shewn that the Supreme has ordered and governed all things to their ultimate good, and to the end that His glory should appear, then must we admit that, in creating this present world, in which are displayed the extraordinary workings of an intelligent mind, there has been the manifestation of Intelligence most excellent, most prized and coveted even by the heathen, combined also with the most profound gifts of virtue and religion.

Both palæontologist and geologist affirm that their investigations lead to no other conclusion than that which we have all along endeavoured to set forth, that there has ever been a mutual dependence in the order of creation of one part on another, and that the life in the world has been always *preceded* by those changes which have been found ever to be the best adapted to the wants of in-coming beings. Plants and animals are found to have been created at particular epochs, and even allied forms and mere varieties have been re-introduced, apparently in accordance with that perfection of plan which is strongly marked in all the events of nature. When, therefore, Mr. Miller and some other geologists declare that there is no break, for instance, between the close of the tertiary and commencement of the quaternary period, they are certainly dealing in somewhat reckless assertions, since it is quite certain that there is evidence enough to induce us to pause and much closely investigate the facts of the history of the past, which seem to point to very different conclusions.

It will be well to keep in mind that the plan of creation was not worked out at once, but was an improving and enlarging progression; and that the mighty changes which have taken place in the inorganic world were necessary to the perfecting of the scheme of animal and vegetable life. We are apt apparently to overlook this fact, and to suppose that the life of the globe has been subservient to changes in the inorganic kingdom which are grand and very stupendous; but what do we learn was the meaning of the no less wondrous creation of plant and animal life which, from the early history of the world, has come down the stream of time, enlarging its proportions, and, with prophetic majesty, proclaiming the advent of a being combining within himself the dispersed and scattered attributes of perfection, which, dwelling now in this animal and now in that, were nevertheless but senseless unreasoning witnesses to the glory of their maker. Suppose an intelligent being to have stood on the earth at the termination of the tertiary epoch, imagine such an one endowed with the wisdom only, of a Cuvier, an Owen, an Agassiz: let him proclaim the transcendent beauty and glory of the thousand forms which lie buried in the rocky beds of byegone worlds; mark the wonderful secret of nature which is revealed as age by age is passed, one furnishing the key by which to tell the true history of the other, the very frame-work of each race telling of the advent of others, the promise of whose coming is in the mysterious fashioning of the limbs and appendages, the bones and the teeth of the prophetic type which is there. But such a being, as one endowed with intelligence, may, nay, must go further: his mind cannot refuse to survey the mental phenomena of beings, and the life attributes which they display: he looks to humble creatures, whose tiny forms would, but for their wondrous life, scarce attract his attention; and finds, in their daily history such startling wonders of skill, and incomprehensible solutions of the most subtle problems of social economy, which the brightest intellects struggle to define and settle: again he finds works of art, of consummate skill, accomplished by unreasoning creatures, which the mathematical genius of a Maraldi and a Brougham could alone solve. The bee builds its cell on the most correct mathematical principles; the ant governs his republican society with matchless wisdom; the beaver constructs his home with a profound skill, which the most thoughtful and forethinking mind might well be pleased to imitate. Do they understand what they do? Are they capable of reasoning on what they do? Still continuing his investigation, the ponderous elephant would exhibit that wonderful power which comes so closely up to reason as well nigh to touch the dividing line, which separates the mind from mere animal instinct; furnishing an example of intelligence in a creature some way removed from that quodrumanous tpye which, in its external configuration, and in some respects in its external structure, approaches that being who is the last and most perfect of the whole creation. But what an unfinished work does he contemplate: harmony and beauty prevail, but where is the creature to *understand it:* law and order reign, but as yet which among the created things can tell of the might, majesty, and goodness of their Creator? Heathens saw the necessity of this, and gave thanks that they were above the brutes. Lord Brougham has aptly directed attention to the discussion held by Socrates with Aristodemus, in which, after enumerating the various bodily organs, he adds: "Nor has the Deity been satisfied with taking care of body alone; he has implanted in man what is a far greater work to have made—a most excellent soul; for what other animal possesses a mind that can perceive the existence of the Gods, by whom all these vast and fair works have been formed? What other creature than man worships those Gods? What other intelligence is superior to man's, in providing against hunger, and thirst, and cold, and heat; or in the curing disease. or in exercising strength, or in cultivating learning, or in storing up the recollection of things heard, and seen, and learned?" In like manner, the discussion with

Euthydemus, after shewing the goodness of the Gods in adapting all things to man's use, closes with mentioning the senses given to us to enjoy those gifts of external nature, and, lastly, the use of reason: "They have implanted reason in our nature, whereby we enquire touching external things; and arranging and remembering, we learn the use of each, and hit upon many contrivances for attaining good, and avoiding evil. Have they not also given us the gift of speech, by which we can communicate mutually all we have learnt, and thus instruct each other, and make laws and regulate civil polity." To which we may add, "Has He not, in these latter days, spoken to us by His Son, and confirmed our immortality?"

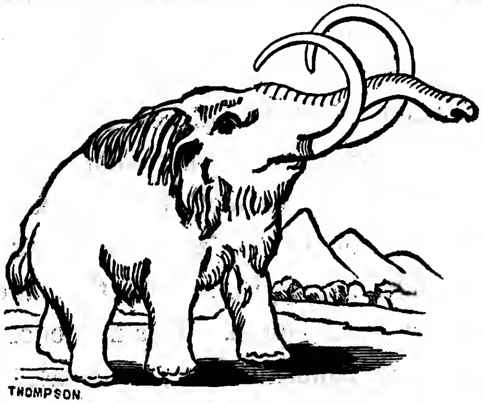
Surely, then, we do not reason falsely when we declare that the whole scheme of creation plainly testifies that the changes which we note in the progress of the great work were changes always with reference to the ultimate manifestation of Divine goodness. Nor can we fail to allow another admission, that as *the plan* approached its completion, there would necessarily be, in the bringing forward of its several parts, a repetition of them or some of them. Let us examine this point a little. Mr. Miller, in Testimony of the Rocks, has not failed to suspect this to be the case; and we feel certain that both the researches of Owen and Darwin abundantly substantiate it as a law. "We at least know," says

Miller, "generally, that with each succeeding period there appeared a more extensively useful and various vegetation than that which had gone before. We may refer to the sombre unproductive character of the earliest terrestrial flora with which we are acquainted. It was a flora unfitted apparently for the support of either graminivorous bird, or herbiverous quadruped. The singular profuse vegetation of the coal measure was, with all its wild luxuriance, of a resembling cast. So far as appears, neither flock nor herd could have lived in its richest and greenest plains; nor does even the flora of the oolite seem to have been in the least suited for the purposes of the shepherd or husbandman. Not until we enter on the tertiary periods do we find floras amid which man might have profitably laboured as a dresser of gardens, a tiller of fields, or a keeper of flocks and herds; nay, there are whole orders and families of plants which do not appear until late in even the tertiary ages. Some degree of doubt must always attach to merely negative evidence; but Agassiz finds reason to conclude that the order of the rosaceæ—an order more important to the gardener than almost any other, and to which the apple, the pear and quince, the cherry, plum, peach, aprecot, almond, raspberry, &c., belong, together with all the other roses and the potentillas—*was introduced* only a short time previous to the appearance of man. And the true grasses—a still more important order—scarce appear at all in the fossil state. The earlier flora of this tertiary division presents an aspect widely different from that of any of the previous ones. The ferns and their allies sink into their existing proportions, nor do the coniferæ, previously so abundant, occupy any longer a prominent place. On the other hand, dicotyledonous herbs and trees, previously so inconspicuous in creation, are largely developed.* Trees of those amentiferous orders to which the oak, the hazel, the beech, and the plane belong, were perhaps not less abundant in the eocene woods, than in those of the present time: they were mingled with trees of the laurel, the leguminous, and the anonaceous, or custard apple families, with many others; and deep forests in the latitude of London, (in which the intertropical forms must now be protected with coverings of glass, and warmed by artificial heat,) abounded in graceful palms. *The nearer we approach to existing times, the more familiar in form and outline do* the herbs and trees become. We detect, as has been shewn, at least *one* existing *order* in the ferns of the coal measures; we detect, at least, existing genera among the coniferæ, equisetaceæ, and cycadaceæ of the oolite: the acacias, gourds, and laurels of the eocene flora, and the planes, willows and buckthorns of the miocene—though we fail *to identify their spe-*

* It must not be forgotten that, by the term "largely developed," is meant "introduced"—"created."

cies with aught that now lives—still more strongly remind us of the recent productions of our forests or conservatories; and in entering on our downward course—the pleistocene period—we at length find ourselves amid familiar *species*. On old terrestrial surfaces, *that date before* the times of the glacial period, which underlie the boulder clay, the remains of forests of oak, birch, hazel, and fir have been detected,—all the familiar species indigenous to the country, and which still flourish in our native woods. The late Prof. E. Forbes held that the most ancient of his five existing British floras—that which occurs in the south-west of Ireland, and corresponds with the north-west of Spain and the Pyrenees—had been introduced into the country as early, perhaps, as the times of the miocene. Be this as it may, there can rest no doubt of the *great antiquity* of the prevailing trees of our indigenous forests. The oak, the birch, the hazel, the Scotch fir, *all lived in what is now Britain ere the last great depression of the land.* The gigantic northern elephant and rhinoceros, extinct for untold ages, forced their way through their tangled branches; and the British tiger and hyæna harboured in their thickets. "Tigers and hyænas," says Miller, "entirely different from the intertropical species; as much so as the ass from the horse, or the dog from the wolf, while there is evidence to shew that they were natives, and had not lived in tropical countries."

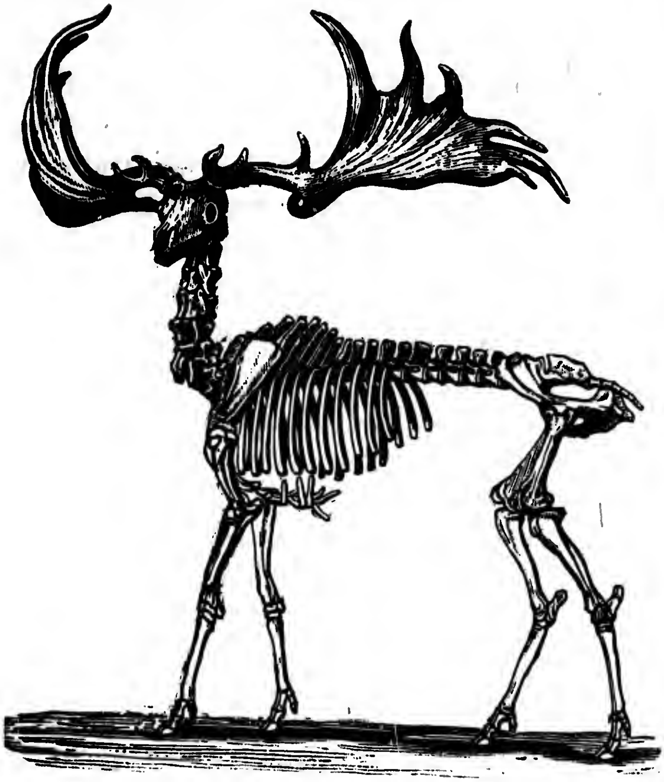
It cannot escape notice that the geologist here admits a re-introduction of plants, for they flourished on land which has been submerged and again re-elevated; and from evidence elsewhere gathered, we find them, in their last introduction, restricted, as it were, within a narrower area, while the animals which roamed through the thickets, or sheltered beneath their shade, have been confined to the warm areas of the present earth: thus, we find that the mastodons—closely allied to the elephants—had their head-quarters in North America, but extended also to Europe and Asia; and the elephants themselves, of several species, were spread over the northern hemisphere, even to the polar regions. The hippopotamus, the rhinoceros, and other creatures *now exclusively tropical*, were also inhabitants of the same northern latitudes. From some specimens of rhinoceroses and elephants of this period, which seem to have been buried in avalanches, and thus to have been preserved from decomposition, we learn something of the climate that prevailed. The very fact of their preservation by frost, shews that it was not a tropical climate in which they lived; and the clothing of the thick wool, fur, and hair, which protected the skin of the mammoth or silurian elephant, tends to the same conclusion. At the same time those regions were not so cold as they *now* are. The district in which the remains are found, in almost incredible abundance, is the coast of northern Asia which bounds the polar sea. The trees of a temperate climate—the oak, the beech, the maple, the poplar, and the birch—which now attain their highest limit somewhere about 70° of north latitude, and then are dwarfed to minute shrubs, appear there to have grown at the very verge of the polar basin; in the condition of vast and luxuriant forests. Now we would ask of the unprejudiced mind, to what conclusion do these several facts point? We have here before us a series of renovations and adjustments, which are not dependent on the mere migration of animals and plants from one spot to another, because becoming more suited to them; but we have positive proof of the existence of animals and plants of a kind like those now living in special *localities*, which were formerly spread over larger sections; and, as we approach the more recent period, even the same geographical homes occupied by kindred races. Are we to suppose that these respective organisms lived through the mighty changes which the earth passed through? This idea is negatived at once, by the fact that the animals and plants were not of the same species as exist at the present time; and even if, at the close of the last epoch, some are exactly alike, their presence and re-creation cannot invalidate a law which was of *general* import, and which controled the ultimate accomplishment of the perfect plan. We have already referred to the researches of Dr. Falconer; we now point to the conclusions to which his researches have led him, in order to shew that there has virtually been a positive re-creation of animals at each of the epochs of creation. "The mastodon, they say, found in the red and Norwich crag, *was*, till lately, regarded as a miocene or falunian species; and, under this persuasion, calling it M. *augustidens*,



ELEPHAS PRIMIGENIUS.

on the authority of Prof. Owen, it was suggested by Mr. Lyell, that its remains might have been washed out of the strata into the crag. Many teeth of this mastodon, together with numerous ear-bones of whales, have recently been found at Felixstowe, in what is called the 'detrital bed,' so rich in phosphate of lime. That accumulation of drifted materials lies at the base of the red crag, and it has been supposed that the imbedded mammalian fossils were derived from the destruction of an older set of strata. But in regard to the mastodon above mentioned, Dr. Falconer declares that the fossil is a well known pliocene animal, first observed in Auvergne by M. M. Croizet and Jobert, and called by them mastodon *avernensis*. The entire skeletons of both these animals having now been obtained, they are found to be referable to *two distinct* sub-genera. The crag fossil belongs to the tetralophiodon, (*τετρα,* four, λοφειον, a small crest) a small *genus*, of which five species are known, and so called because there are four ridges in the penultimate true molar, as well as in the two teeth which are placed immediately before it in both jaws. The mastodon augustidens, (*augustus* narrow, *dens* a tooth,) on the other hand, belongs, with six other species, to the section called trilophodon, (three-ridged,) in which the corresponding teeth have three ridges. This mastodon is *characteristic* of the faluns, and of the molasse at Sausan, at the foot of the Pyrenees, and of several other *miocene* localities. No one, we presume, would say that the hairy elephant was not typically the same animal as the elephant of to-day. He is not precisely the same, but still of the same class, and may be but a variety of the hairy elephant of the Himalayas, seen by Bishop Heber, and heard of by Hooker, as yet in Upper India. Similar evidence of the re-introduction ofanimal life may be had from Prof. Owen's collection of fossils of Britain, who most significantly descants on the remarks of those naturalists who suppose the present race of animals to be descendants of those which went before them in previous epochs. Prof. Owen observes, "Dr. Molyneux, to whom we owe the first account of the remains of the gigantic Irish deer, and by whom they were regarded as a proof that the American moose was formerly common in Ireland, prefaces his description with the following observation: 'that no real species of living creatures are so utterly extinct as to be lost entirely out of the world since it was first created, is the opinion of many naturalists; and it is grounded on so good a principle—of Providence taking care in general of all its animal productions—that it deserves our assent.'" The numerous and incontrovertible, though marvellous results of modern palæontology, place in a strong light *the danger* of such a "petitio principii," or presumption of the way in which the benefits of a good Providence are dispensed; and the fallacy of the conclusion founded thereon, in the present instance, is shewn both by the now well-determined diagnosis of the American moose, whose dimensions were much exaggerated in the earlier notices of the wild beasts of the North American colonies, and by the exact comparisons of the osteological characters of the megaceros of all other known cervine animals.

Recent discoveries of the entire skeleton of the megaceros, have shewn that the proportions of the trunk and limbs to the vast antlers were not the same with which we are familiar in the existing deer—best provided with these weapons—but that the



GIGANTIC IRISH DEER.

antlers were both absolutely and relatively larger in the extinct species: this, in fact, constitutes one of its best characteristics, and involves other differences in the form and proportions of its osseous framework. One of the modifications in the skeleton of megaceros, which relates to the vast weight of the head and neck, is the stronger proportions of its limbs; and another, and more striking character, is the great size of the vertebræ of the neck, which form the column immediately supporting the head and its appendages ; these, and other differences, pointed out by Prof. Owen, establish its specific characters. Another instance of re-construction we may adduce, the macacus eocœnus, also figured and described by Prof Owen ; he observes, "I have been so fortunate in my researches on the fossil mammalia of Great Britain, as to determine not only the remains of extinct pachydermal animals in the eocene beds called London clay, but likewise of a quadrumana or monkey, in a sandy strata of the same formation, the epoch of which has been shewn by Mr. Lyell, from the evidence of other organic remains, to have had a temperature sufficiently high for arboreal mammalia of the four-handed order."

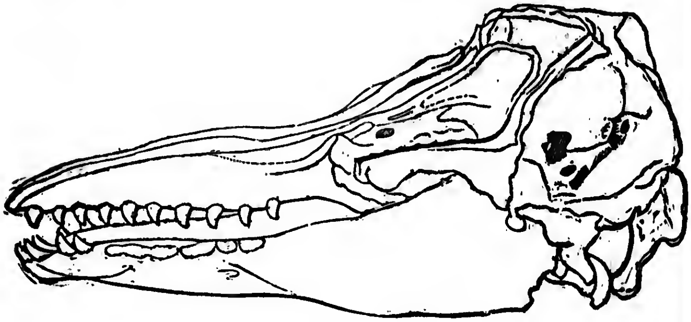
The evidence on which the fossil monkey in the eocene strata of England has been determined, is of the same kind as that which has brought to light *the former existence* of another and higher species of quadrumana in the south of France, and is equally conclusive with that by which quadrumana fossils have also been recognised in India and in South America. Dr. Lund writes, "I am at length enabled to solve the important question as to the existence of the highest order of mammalia (quadrumana) in those ancient times to which these fossils belong. It is certain that this order was then in existence, and the first animal of this class recovered is of gigantic size—a character belonging to the organisation of the period." Again, in reviewing, says

MACACUS (of present time.)

the same author, the general position and distribution of the fossil remains of the genus equus, or horse, we find that this very remarkable and most useful form of pachyderm made its first appearance with the rhinoceros, during the *miocene* tertiary period of geology. From the peculiar and well-marked *specific* distinction of the primordial or short-legged horses (hippotherium) which ranged from central Europe to the then rising chain of the Himalaya mountains, it is most probable that they would have been as little available for the service of civilised man as is the zebra or wild ass (equus hemionus) of the present day ; and we can as little in the docility of the later or pliocene species—*equus plicidens* and *equus fossilis*, the only ones hitherto detected in Britain—from any characters deducible from their known fossil remains. There are many specimens that cannot be satisfactorily distinguished from the corresponding parts of existing species: equus caballus, which, with the wild ass, may be the sole existing survivors of the numerous representatives of the genus equus, in the European and Asiatic continents, during the pliocene period. The species of *equus* which existed during that geological period in both North and South America, appears to have been blotted out of the fauna of those continents before the introduction of man. The researches of Mr. Darwin and Dr. Lund have shewn that the genus equus was represented in South America during the pliocene period, by a species—equus curvidens—which has been shewn to be distinct *both* from the European *fossil* and the *existing* species.

Now, what we again ask, are these but instances of the continuance of several families of animals, by the re-introduction of them under modifications suited to each particular period? and we do also notice that the peculiar lines of demarcation between them, as in the horse and mastodon, are sometimes so difficult of detection, as to escape the notice of unquestionably learned palæontologists.

The evidence afforded by extinct fossil delphinidæ and cetacea, are to the same effect; and the specimens figured by Mr. Owen indicate decided specific distinctions between extinct and recent species.



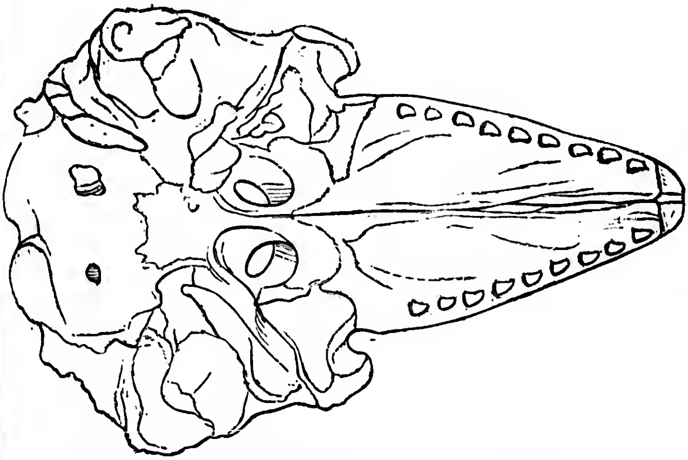
SKULL OF THICK-TOOTHED GRAMPUS.

The most complete example of the skeleton of a cetaceous animal which, by the alteration of the osseous texture, and by the peculiar configuration of the bones, claims to rank with the British fossil mammalia, is that which was discovered in the year 1843, in the great fen of Lincolnshire, beneath the turf, in the neighbourhood of the ancient town of Stamford, and which is now preserved in the museum of the Stamford Institution.

In the above figure, the skull, which is [almost entire, and the teeth, some of which are preserved in the lower jaw, proved the animal to have belonged to the dolphin tribe, (*delphinidæ*,) and to the short-jawed or porpoise genus, (*phocæna*,) and herein to be comparable, in point of size, with the round-headed porpoise, (*phocæna melas*,) the grampus, (*phocæna orca*,) and the beluga (*phocæna leucas*).

The *phocæna crassidens* differs from the *phocæna melas* in the relatively larger temporal fossæ, by which it resembles the grampus; and it differs from *ph. orca*, and resembles the *ph. melas* in the continuation of the intermaxillary bones backwards to the nasal bones, which they join; but, in the breadth of the intermaxillaries, it is intermediate between the *ph. orca* and *ph. melas*.

I have seen no specimens of these existing British *delphinidæ* meriting to be regarded as fossils; the subject of the present section presents characters by which it differs not only from the known existing *delphinidæ* of our own coasts, but from all the species that have been so described and figured as to admit of a comparison.



BASE OF SKULL OF THICK-TOOTHED GRAMPUS.

We may sum up these proofs of re-introduction by a fact from H. Miller, and a significant query from his latest work: "In the coal period we find great conifers, so great that they must have raised their heads more than a hundred feet over the soil. Though marked by certain peculiarities of structure, they bore, as is shewn by the fossil trunks of Granton and Craigleith, the familiar outlines of true coniferous trees; and would, mayhap, have differed no more in appearance *from their successors* of the same order that now live in our forests, than these differ from the conifers of New Zealand or of New South Wales.

"The forms borne by most of the oolitic plants were comparatively *familiar* forms. With the acrogens and gymnogens, we find the first indication of the lily-like plants; of plants, too, *allied* to the pandanaceæ or screw pines, the fruits of which are sometimes preserved in a wonderfully perfect state of keeping in the inferior oolite; together with carpoliths—palm-like fruits, very ornately sculptured—and the remains of one, at least, other monocotyledon that bears the somewhat general name of an endogenite. No true fossil palms have yet been detected in the great oolitic and wealden systems, though they certainly occur in the great carboniferous and permian rocks, and are comparatively common in the earlier middle and tertiary formations. Much cannot be founded on merely negative evidence; but it would be certainly a curious circumstance should it be found that this graceful family, first ushered into being some time in the later palæozoic periods, was *withdrawn* from creation during the middle ages of the earth's history, to be again introduced in greatly more than the earlier proportions during the tertiary and recent periods." We believe that we may safely accept the proposition laid down by Mr. Lyell, "That in proportion as the age of a tertiary deposit is *more modern*, so is its fauna more analogous to that now in being in neighbouring eras." We humbly and sincerely differ from him in another inference, that the law which has governed the creation and extinction of species, seems to be expressed in the couplet of the poet Ariosto,—

Nature made him, and then broke the die.

So far from this being strictly true or a just interpretation of the law, we think it has been clearly shewn, that the pattern, having been pronounced good, has been preserved, and handed down improved through a great many changes of time and place. Will Mr. Lyell maintain, that the macacus and megatherium and elephants of old are cases of utter breaking of the die?

We know not how the sceptic can refuse to admit the abiding power of an Intelligent Will, capable of combining and harmonising a stupendous scheme of organisation in its largest sense. We have passed in review instances of repeated interposition of creative energy, fresh acts of power, wisdom, and goodness. Verily there is a God that judgeth the earth. "When thou hidest Thy face they are troubled: when Thou takest away their breath they die. When Thou lettest Thy breath go forth they shall be made: and Thou shalt renew the face of the earth."

BOOK III.

The modern epoch—the reign of man—succeeds to, but is not a continuation of, the tertiary age. These two epochs are separated by a great geological event, traces of which we see every where around us. The climate of the northern hemisphere, which had been, during the tertiary epoch, considerably warmer than now, so as to allow of the growth of palm-trees in the temperate zone of our time, became much colder at this end of the period, causing the polar glaciers to advance south, much beyond their previous limits. It was this ice—either floating as icebergs, or, as there is still more reason to believe, moving all along the ground, like the glaciers of the present day—that, in its movement towards the south, rounded and polished the hardest rocks, and deposited the numerous detached fragments brought from distant localities, which we find every where scattered about upon the soil, and which are known under the name of erratics, boulders, or greyheads. This phase of the earth's history has been called by geologists the glacial or drift period. After the ice that carried the erratics had melted away, the surface of North

America and the north of Europe was covered by sea, *in consequence of the general subsidence of the continents.* It is not until this period, that we find, in the deposits known as the diluvial or pleistocene formation, incontestible traces of the species of animals now living. It seems, says Agassiz, from the latest researches of geologists, that the animals belonging to this period are exclusively marine, for, as the northern part of both continents was covered to a great depth with water, and only the summits of the mountains were elevated above it, as islands, there was no place in our latitudes where land or fresh-water animals could exist. They appeared, therefore, at a later period, after the water had again retreated; and as, from the nature of their organization, it is impossible that they could have migrated from other countries, we conclude that they were created at a more recent period than our marine animals. Among the land animals which then made their appearance, *there were representatives of all the genera and species* now living around us, and, BESIDES THESE, many types now extinct, some of them of gigantic size, such as the mastodon, the remains of which are found in the uppermost strata of the earth's surface, and probably the very last large animal which became extinct before the creation of man. The important facts just narrated, afford most interesting illustration of the truth of the Mosaic record, and tend strongly to confirm the correctness of that most interesting history. It is certainly a remarkable fact that geology should reveal to us a condition of the earth, at the close of the tertiary period, in which the continents are submerged, and its mountain summits only, as islands, appearing above the surface of the deep, while an ice-wrapt covering would seem to have been the mantle which clothed even these isolated lands. So utterly unfitted for habitation was the condition of the earth at this time, that, as M. Agassiz declares, it is necessary to distinguish two periods in the history of the animals now living: one in which the marine animals were created, and a second during which the land and fresh-water animals made their appearance, and, at their head, MAN. Why this special arrangement should be supposed to have been followed we are at a loss to understand; and when we consider the laws of mutual dependence and adaptation which govern the distribution of animal life, and vegetable life also, on the surface of the earth, it is impossible to reconcile the existence of these laws with the complete abnegation of them, which is involved in the hypothesis of M. Agassiz. His admission that there was a *similarity* to the living fauna, and among the vertebrata especially, in their increasing resemblance to man, and this not in consequence of a direct lineage between them, is fatal to the objection evidently implied, of the non-introduction of extinct forms in the case of sea-animals. Is there one law for the governance of life periods in aqueous areas, and another for the inhabitants of terrestrial ones? No one has laboured more successfully to establish the law of life periods for the race, family, and individual, than the learned and laborious Swede; how then shall we reconcile his present theory with the other great facts of natural history? We therefore look for a wiser solution of the question; and, guided solely by the interpretation of the facts, and by the laws of nature, we close the tertiary period as a concluded book and witness to the introduction of the human period, and its associate life, as the beginning, the inauguration of a new history of life, a new volume of the great work of creation.

We have already pointed out, what every one will admit, that there must be a supply of races of beings, in order to preserve the balance of creation; the vegetable and animal kingdoms sustain each other: destroy the proportions, and all would sooner or later perish. Now if a catastrophe of so general a nature was to occur, as to be capable of blotting out the terrestrial organisation, is it at all reasonable to suppose that the aquatic races would escape destruction? The very change of level, and variation of sea-bottom, or depth, would injuriously affect large classes, and the breaking up of their geographical homes would exterminate others. The great difficulty in understanding their preservation, renders miraculous intervention on their behalf necessary.

That sudden re-arrangements of the earth's surface have occurred, we have evidence ; and as regards the life of the globe, the introduction of it must have always been in a short time. "For," observes De La Beech, "every day's experience in geological research, will shew the observer that he has to consider the surface of the earth to have been in an unquiet state, from remote geological times to the present; and that while he so often stands amid stratified deposits, on ancient sea-bottoms now elevated to various altitudes above the ocean level, many a region shews that its area has more than once been beneath that level and above it. Thus, although a mass of land may now rise above the level of the sea at the south pole, separated by a broad band of ocean from other great masses of land to the northward, producing certain effects as regards the climate of that part of the globe, and the northern polar regions are otherwise circumstanced, it by no means follows that such has always been the case, even in more recent geological times. If we change the conditions of the two polar regions, a difference of results is obtained, of an important geological character." Mr. Darwin thus skilfully sketches it: "On this supposition, in the southern provinces of France, magnificent forests, entwined by arborescent grasses, and the trees loaded with parasitical plants, would cover the face of the country. In the latitude of Mont Blanc, but on an island far eastward as central Siberia, true ferns and parasitical orchideæ would thrive amidst the thick woods. Even as far north as central Denmark, humming birds might be seen fluttering around delicate flowers, and parrots feeding amidst the evergreen woods, with which the mountains would be clothed to the water's edge. Nevertheless, the southern part of Scotland—only removed twice as far to the eastward—would present an island, almost wholly covered with everlasting snow, and having each bay terminated by ice-cliffs, from which great masses, yearly detached, would sometimes bear with them fragments of rock. This island would only boast of one land-bird, and a little grass and moss; yet, in the same latitude, the sea might swarm with living creatures. A chain of mountains running north and south through the Alps, (but having an altitude much inferior to the latter,) would connect them with the central part of Denmark. Along this whole line, nearly every deep sound would end in bold and astonishing glaciers. In the Alps themselves, with their altitude reduced by one-half, we should find proofs of *recent elevations*, and occasionally terrible earthquakes would cause such masses of ice to be precipitated into the sea; that waves, tearing all before them, would heap together enormous fragments, and pile them up in the corners of the valleys. At other times, ice-bergs, charged with no inconsiderable blocks of granite, would be floated from the flanks of

Mont Blanc, and then stretched in the out-lying islands of the Jura. Who, then, will deny the possibility of these things having taken place in Europe during a former period, *and under these circumstances known to be different from the present*, when, on merely looking to the other hemisphere, we see they are under the daily order of events. The island groups situated in the southern part of Norway, and others in that of Faroe, in the middle of summer would be buried under snow and surrounded by walls of ice, so that scarcely a living thing of any kind would be supported on the land.

Hitherto, continues De La Beech, we have regarded these alterations of level, as *slowly* produced, so that the changes, of whatever kind, were gradual, causing no sudden alteration of conditions. This, however, is very far from necessary in geological reasoning, there being evidence connected not only with actual mountain ranges, but also with many a district wherein the rocks are broken and contorted, which would lead us to infer, with every allowance for the repeated effects resulting from the repeated application of minor forces, that considerable forces had often been *suddenly* called into action. When we carefully analyse the facts which pertain to this great period, it is not going too far to declare that there are the strongest reasons for inferring that we discover the witnesses to that time when it is said that the earth was void and without form, buried beneath a wide-spread ocean, and covered with glacial ice to a considerable extent ; and, with Mr. Darwin, we may view the drift period a · the close of the great tertiary era of geologists.* In that period there was much dry land in the northern hemisphere, and multitudes of large animals, now extinct, inhabited it, apparently under a climate milder than now. Great changes, however, took place in the relative positions of land and water, inducing very important changes of climate, which became finally of an almost arctic character over almost all the present temperate regions. Then the greater part of northern Europe and Asia appear to have subsided beneath the waters of the boulder-bearing semi-arctic ocean, until raised again by the fiat of the Creator, to be the abode of man and animals of the modern earth.

With these facts before us, how can we accept the doctrine of the preservation of part of the life of the time : there could not have been a geographical home for animals or plants. The question of the re-introduction of animal and vegetable life, has been determined, however, satisfactorily in the affirmative, from evidence already existing and discovered by geologists, and by the important labours of Prof. Owen, and the accomplished anatomist Dr. Knox. We have already partly anticipated the evidence of the re-introduction of forms, and refer back to those illus-

* St. Gregory, of Nyssa, says that such an idea was current in early times.

trations in Book II., which bear upon the question; we now particularly discuss the subject, in connexion with the admission of there being an essential difference between the quaternary, or human epoch, and the tertiary, which at its close had many forms which are closely related to those of the present creation. Before, however, we cite the instances of re-introduction of animals inhabiting the sea, furnished by our distinguished countryman, Prof. Owen, it will be well to quote the generalisations of Dr. Knox, whose opinions, as those of a most laborious and scientific anatomist, are universally held in respect. By dissection, he says, the dead are analysed or reduced to certain assemblages of organs, holding relations, often mechanical, to each other. They all perform certain functions, some of which have been imperfectly guessed at; made out in a coarse way: organs of locomotion exist—bones, ligaments, joints, muscles, or flesh; organs of sensation, and thought, and will—the brain and spinal marrow, the nerves; organs of digestion and assimilation—the stomach and digestive tube, and their appendages; lastly, organs of breathing, essential to life—the lungs, by which we draw from the air the breath of life. Blood-vessels acted on by a heart, carry the blood through the frame. Out of this vital fluid the body is constructed, repaired, formed. Now if we select any one of these organs, or sets of organs, we we shall find that, in one shape or another, it extends through the whole range of vertebrate animals, most probably through the entire range of animal life, but under a shape or form no longer recognisable by our senses. A few instances will suffice to explain this. There is no occasion for any minute or technical exposition of facts, which are, as it were, on the surface. Let us first turn our attention to the skeleton. Not that this assemblage of levers proves better than any other set of organs the unity of structure, the unity of organisation sought to be superadded by the German and Slavonian philosophy, to the unity of plan laid down by Newton; I do not even think so well; but it presents materials easier to be handled, easier to be inspected, obtained, and easier understood.

The basis of the skeleton, whether mere animal or man, is a series of bones jointed or articulated with each other. In common language it is called the back-bone. You see how violently inaccurate such a term is, when applied to a series of bones perfectly distinct from each other, possessing most of them a distinct mobility. These bones we call *vertebræ*. When studied by the surgeon or medical man, it is viewed by him merely as a portion of the skeleton; to the philosophic anatomist it becomes the type of all vertebrate animals, of the entire skeleton, limbs and head included; or the organic world, vertebrate and invertebrate. Carried further, it possesses the form of the primitive cell; of the sphere; of the universe.

Now study this bone in man—it appears simple, but it is not so. Originally, that is, in the young, composed of many distinct portions, which afterwards unite with each other, but which remaining distinct in many animals, as in fishes, proves to us, that throughout the whole range of animals so formed, the vertebræ do not really differ so much from each other as might at first appear: that, in fact, the elements forming them seem the same almost numerically, giving rise to the well grounded belief, that, in the embryo, the elements of the skeleton may be, after all, the same in every animal. From man to the whale, all is alike; one theory explains all; one idea or plan pervades all.

Let us trace this chain of bones upwards and downwards; see how downwards (coccygeal vertebræ) certain elements cease to be developed, or do not grow: still the plan is the same; identical; analogous, as regards the individual, that is, repeated; homologous or identical, as regards one animal compared with another. Look to this section of the skeleton, called the head; the bones seem widely different from the vertebræ; but it is not so. They are merely vertebræ, repeated, upon a larger scale as may be required: a chain of vertebræ form, then, the head or cranium. These great truths we owe exclusively to the illustrious South German and

Slavonian schools of transcendental anatomy; to Oken and Spix, Autenrieth, Frank, Goethe, and a host of others. * * *

A vertebra must have a type; that is, a plan, sufficiently comprehensive to include all forms of vertebræ. Now where is this to be found? Is it an ideal type not yet discovered? Or is it to be found in any extinct or living animal? I apprehend that it may or it may not have been found, but this in no way interferes with the principle that there must be a type laid down by nature; eternal; equal to all manifestations of form, extinct or living, or to come.

But the discovery of such a type could only be made were the anatomy of all animals that ever lived known to us; perhaps not even then, for the future must be wrapt up in the past; and what seems to us now a mere speck of bone, a nucleus, a point unimportant, nay, scarcely discernible, may, in a future order of things, become an all-important element. As thus:—

If birds did not exist, we could scarcely conceive the high organisation to which the third eyelid, in man a mere rudiment, attains in them. Not wanted in man, the organ sinks to its rudimentary and scarcely perceptible condition. Of essential service in birds, it suddenly acquires its seemingly highest developement. Yet the organ was always present, rudimentary in one, developed in the other. Let us take another instance.

The adult, or grown-up man, has, as you all no doubt know, three bones to each toe, with the exception of the first; these three bones are connected to each other, and to the metatarsal bone, their supporters, by three joints. In the feet of birds you meet with four or five bones in certain of the toes; and it might seem to you that the feet of birds were formed on a different numerical plan, at least; but it is not so: for in man, as in birds, each digital bone is formed of two elements, or distinct bones, at first, that is, in the young of each: as the bird grows up, they remain distinct—in man, on the contrary, they unite—that is all. The arrangement is not only analogous, but homologous or identical, in the strictest sense of the terms.

Again, remember that a thousand similar instances might be given: I merely select a few of the easiest understood.

In man there is a little cartilage, scarcely perceptible, connected to one of those bones occupying the nostrils, called turbinated bones. It may or it may not in him serve any purpose; that is a matter of pure indifference. It is a rudimentary and a useless organ seemingly. Now, mark the extension and developement of this cartilage or organ in the horse—still more in the whale; in the horse, where it most admirably serves to shut off the great cavities of the nostrils from the vestibular cavities in front—thus protecting them from foreign bodies:

in the whale, acquiring their presumed highest developement, these cartilages, now grown to the size of bolsters, return after breathing, into the vast nostrils of the whale from which they had been momentarily withdrawn, filling them up, sealing them hermetically against the pressure of a thousand fathoms deep of water, which they sustain with ease, when, plunging into the vast abyss of the ocean, the giant of nature seeks to avoid his enemies.

Let us now briefly review the progress we have made in this the highest of all analyses: deepest of all theories: most important to man. Man, we have seen, stands not alone, he is one of many; a part and parcel of the organic world, from all eternity. That organic world is the product of secondary causes. (?) During his growth he undergoes numerous metamorphoses, too numerous even for the human imagination. These have a relation to the organic world. They embrace the entire range of organic life, from the beginning to the end of time. Nature can have no double systems; no amendments or second thoughts; no exceptional laws. Eternal and unchanging, the orbs move in their spheres precisely as they did millions of years ago. Proceeding, as it were, from an invisible point endowed with life, he passes rapidly, at first, through many forms, all resembling, more or less, either different races of men from his own, or animals lower in the scale of being; or beings which do not now exist, though they probably *once* did, or may at some future time. When his developement is imperfect, it represents then some form, resembling the inferior races of men, or animals still lower in the scale of being. Moreover, what is irregular in him is the regular structure in some other class of animals. Take for example the webbed hand or foot occasionally found in man, constant in certain animals—as in the otter and beaver; constant also in the human fœtus, that is, the child before birth. Take, for example, the cuticular fold at the inner angle of the eye, so common with the Esquimaux and Bosjesman or Hottentot, (the corresponding yellow races of the northern and southern hemispheres,) so rare in the European, but existing in every fœtus of every race. Nor let it be forgotten that forms exist in the human fœtus which have nothing human in them in the strictest sense of the term; that the fœtus of the negro does not, as has been stated, resemble the fœtus of the European, but that the latter resemble the former, all the more resembling the nearer they are to the embryonic condition. Unity of structure, unity of organisation, unity of life, at the commencement of time, whether measured by the organic world or by the duration of individual life. This is the law.

The relation of species to genus also merits our deepest attention.

My first observations were made on animals low in the scale of the vertebrata—on fishes, in fact. I selected, as I shall presently more fully explain, the natural family of the salmonidæ, as the one to which I had given most attention. In the young of the true salmon I found the specific characters of all the sub-families of the genus present; that is, red spots, dark spots of several kinds, silvery scales, proportions, and a dentition identical. The young fish before me was, in fact, a generic animal, including within it the specific characters of all the species composing the natural family. To connect this generic animal with any species, you have but to imagine the disappearance of certain characters then and there present. Nothing requires to be added. Take, for example, the dentition—the *dentition of the vomer*, to which M. Valenciennes attaches so much importance, and in which he has endeavoured to discover the true distinguishing characters of the three sub-families into which that distinguished naturalist subdivides the salmonidæ. Look at these vomerine teeth in the young of any of the species—that is, as I view it, in the *generic animal*, and in the adult of all the species, that is, in the animal *specialised*—and we shall find that the *generic animal* possesses a dentition embracing all the characters by which the fully-developed individuals are afterwards to be recognised. But it is the young alone which comprises all, combines with the anterior group of teeth (teeth of the chevron) a double row on the body of the vomer, which row, becoming in due time single, characterises, according to M. Valenciennes, the adult of the sub-family forelle, or, disappearing altogether, marks the true salmon when adult, the common trout growing up with the dentition of the generic animal. The primitive type, then, is not lost, as M. Valenciennes seems to have supposed, but is retained in one species at least of the natural family. As with the dentition, so with the colouration and proportions: and thus the law of generation being *generic*, and not *specific*, marks the extent of the natural family, its unity in time and space, the fixity of its species, the destruction of some and the appearance of others being but the history, not of successive creations, but of one developement, extending through millions of years, countless as the stars of the firmament.

Look now at the colt a few months old as it gambols through the fields, and say, does it resemble the domestic animal from which it is sprung, in colour, proportions, movements, attitudes? Not in the least. Its colour is a rich deep fawn, to be found only amongst the *wilde;* in its proportions it resembles the quagga or zebra, and as it canters along, its rocking-horse motion and short frisking tail recall to the mind scenes only to be seen in Southern Africa, on the plains of the Koonap, or the slopes of the Winterbergen, where roams the wild horse, to which this young of a domestic horse bears the strongest resemblance. The obvious inference is, that even in animals so high in the scale of mammals as the solidungula, the young is a *generic animal*, including in it the colour, proportions, movements, and habits of the genus or natural family of all its species, wherever placed, and representing, more especially in this instance, a wild species of that family, never domesticated or subdued by man. Even here, where we should expect *specific* and other influences to have told strongly on the product —that is, the young, we find the *generic* law to be in full force, and that the young of the domestic horse resembles a species peculiar to another region of the earth. The natural family, then, of the solidungula embraces in the young of each species all the forms which it, the genus, can or has assumed on the earth. The quagga and the zebra may become extinct; but their forms remain in the generic young of whatever species still lives. The fossil horse belonged, no doubt, to the same family; as the exterior is lost, the precise species cannot now be determined. That he belonged to any species now living I do not believe; but he was of the family, and may appear again. Thus the successive appearance of new forms or species is no new creation, but merely the developement of forms already existing in every natural family. The extinction of species which has gone on through millions of years has led some to the belief that nature hastens onwards to the extinction of life on the globe. It is possible; but I lean to the opposite opinion, believing that living nature will have no end. That which has been may be again, the potentiality existing in every species of every natural family; and to this creed point the infinite affiliations of germs, not confined to natural families, but extending to all that lives. These are speculations on which I do not enter. Primordial forms are visible in all germs; the germs themselves must be eternal.

If we enquire into the law of generic forms lower in the scale, as in fishes, to which I have just alluded, we find still stronger confirmation of the point I now seek to determine. The natural family of the salmonidæ, as the one with which I am best acquainted, was that fixed on for the enquiry. Look at the young salmon when but a few inches in length, and you will find that in its dentition, colouring, and proportions, it is not a *specific*, but a *generic*—*i. e.*, it possesses (and is therefore perfect) all the natural history characteristics of the three sub-families into which the salmonidæ have been divided. At first, for example, its dentition is the type of the common trout; as it grows it assumes the character which we find to prevail in some of the forelle or sea-trout. Lastly, it assumes the true salmon dentition; but that which especially merits attention is, that the original type of the generic being is of a character so ample as to embrace all possible forms which the dentition can assume in any species of that natural family. Nothing is wanting; nothing new appears: nothing has to be supplied; all is foreseen; all provided for. To institute a species, all that is required is to omit, or cause to disappear, or cease to grow, some parts of the organ or apparatus already existing in the generic being. In every natural family there is a species which bears, to the generic animal, that is, to the young, a stronger resemblance than any other. In the salmonidæ it is the common trout of freshwater rivers, but there may be others. In the solipede it seems to be the quagga of Southern Africa.

We can by no means accept Dr. Knox's speculations on the eternity of the material universe, since the facts of geology afford a complete refutation of his idea of continuous descent. We are therefore released from the duty of adducing in this place any arguments to subvert his theories on this head. Profs. Owen and Agassiz both ignore the possibility of connecting the extinct with present races, by lineal series. With this caution, Dr. Knox's conclusions and observations, carried on carefully for some time in the class fish, entirely corroborate and explain why we should expect to find the re-introduction of extinct forms, either with some variations, or as transitory forms, which idealise their connexion with the past, and furnish cogent proof that the same Divine Mind has been ever engaged in the works of nature. In his Notes to

Milne Edwards' Manual of Zoology he says: "These deductions are alike interesting to the philosopher and more simple believer; they do most clearly indicate a future, and point to that higher state, to which it needed that revelation should conduct us." In strict accordance with Dr. Knox's, are the conclusions of Prof. Owen; and an examination of his "British Fossil Mammals and Birds" will satisfy us, that even in the class fish there is enough to shew that M. Agassiz's doubts and difficulties are set aside by the fact, that even among the higher aquatic animals, re-introduction has been effected.

The evidence with regard to the whale family is clear; and in summing it up, Prof. Owen says: "We have four species of cetacea referrable by the form of the tympanyc bones to the whale family, but distinct from all known existing species of that family, are more definitely indicated by the remarkable fossils termed cetotolites; and it is not improbable that these and the teeth may have been parts of the same cetaceous animals. We know that the great whale-bone whales of the present day, before their jaws acquire the peculiar array of baleen-plates, manifest a true dental system, although the fœtal teeth are transitory, and never destined to cut the gum; and as the embryos of existing ruminants feebly and evanescently manifest in the dark womb, by their upper incisors, their divided canon bones, and boneless forehead, the mature and persistent characters of their ancient predecessors, the anaplotheria, so may the equally ancient whales of the eocene seas have retained and fully developed those maxillary teeth, which are transitory and functionless in the existing species."

Both, then, Messrs. Owen and Knox testify to the restoration of forms, and adduce the strongest reasons for believing, that in order to preserve the harmony of the plan of creation, re-constructions not only have been, but must have been effected. So far from the class fish forming any valid objection to the doctrine, as stated above, it would be most difficult to believe that there was one law which had reference to land animals, and another to fish. We discover so undeviating an adherence to *the plan* of creation, as laid down in "the beginning," that we are almost tempted with Dr. Knox to say, that strictly, there cannot be said to be a new creation, but the unfolding and reaching forward to the exhausting in perfection that Divine conception which first ushered into existence the material universe. All is grand, all significant of an end to come, all wonderful, all declaratory of a Supreme, Intelligent Mind, as we stand on the cold ruins of the glacial world, and look back on the past. It is not until we turn our thoughts from this crash of matter and wreck of worlds, and scan the renovated earth, as it exists in the present age, that the hitherto incomprehensible becomes open to comprehension; and man, the last born of earth, crowns His Maker's work, and, in the lineage of that Maker, declares a new creation indeed to have been accomplished, a moral and religious universe to have been fashioned. Praise, adoration, dominion, and power, is chanted to heaven; thanksgiving and great glory are rendered by a race of beings having the high gift of reason, and immortal by the breath of Him who is immortality. Having, then, been endowed with faculties and powers transcending far all the creatures of his time, man sums up in himself all the excellencies and powers of earthly creations, and in his more pure and exalted condition, as well as in his depressed and more animal existence, plainly discovers that a future lies before him. We know that his advent on earth has been the last of the creations; and experience illustrates the high dominion which he exercises over all the world. Created in perfection, he left his Maker's hands endowed with knowledge; and if in his singular history there be lamentation, and mourning, and woe, nevertheless the purport of his existence is not changed, and the Great Creator who has not left Himself without witness, has never quenched the sacrifice—ceased to demand worship from, or utterly cast off, the work of His hands. And now after ages have passed, and families have become nations, when we try to trace back the parentage of each, nowhere do we find the birth to be in ignorance, but at once the earliest and best known are the wise ones of the earth; and when we do encounter fools, they are the degraded and rebellious off-shoots of intelligent sires. The history of man affords conclusive evidence of the wisdom and goodness of Jehovah; and although there may be much in that history which is difficult to understand, yet enough may be disclosed to satisfy us, that as children of one family, we have a common Creator and God; whom to serve is the highest privilege; to worship, the greatest delight.

Strange, then, is it to find a being so highly gifted prostituting those very gifts, and instead of the one family uniting in one common union of good, they have basely permitted a diversity of evil to pervert and mar their happiness. Mind and body alike have become corrupt; and each, shut up in the spheres of their own degradation, have become centres from whence flow, in rapid descent, the accumulating consequences of vice. Such are the divisions at the present time, and so complete the isolation of races, that strong temptation inclines the more intellectual and civilised to suppose their fallen and brutalised kindred to be members of another stock. Swift is declension: deterioration rapidly supervenes on the fall from civilisation. The time which has elapsed since the creation of man has sufficed to bring him under the influence of those external circumstances which surround him; and these, together with the laws of his own nature, have wrought changes such as are found to distinguish men from each other, and to enable them to be designated by the regions which they severally inhabit. Here, as in the history of the world, we have to seek for information from recorded history; and it is a duty to interrogate its pages deeply, and to leave speculation entirely to those points on which the past is silent. In contemplating the history of man, we are studying a creature who is the object of a moral and religious government, and whose duty lies in obedience to its laws, and the perfecting himself for the enjoyment of an eternity of bliss.

His advent on earth was, it must be admitted, the commencement of a new era in the work of creation —the formation of a being possessing God-like attributes; capable of understanding the supreme wisdom and goodness of his Maker, and endowed with a capacity to receive increased happiness, having that within him which may hold converse with truths that sense has never given and never could give: with truths that are real, manifesting themselves in our conscious intelligence as the images of eternal realities centring in God. It was the constitution of such a being that formed the link which connected the creation of the earth with holier creations in heaven. He is nevertheless of the earth, earthy! The material fabric, conjoined with compound essential indwelling realities, constituting him a compound creature, on the one hand related to earth-born beings of his own time—to the world of which they both form a part, and to that Supreme Spirit who breathed upon him that breath of immortality which can never be quenched. Thus, if the genius of an Owen, an Agassiz, and a Knox has taught us to read in the members of an organic creation, a continuous striving after perfection: if, in the exterior framework, type and ante-type are given, no less in the "life" which has been conjoined to these perpetual re-orderings of the material fabric, do we discover unmistakeable reachings forward to that "ideal perfection," which culminated in that Being who, cradled among the beasts of the earth, taught us to despise nothing created; and who, sanctifying our nature, and by the sinless purity of His all-holy life, left humanity a witness of the essential meaning of that life, and by His glorious death convinces the child of flesh of the end of his creation—an eternity of good.

Because, therefore, we discover at various points of the earth, varieties of men adapted to conditions of climate and other circumstances, we are not thereby justified in drawing the conclusion that each of these respective families is a separate race, created at the spot on which we find them; thus cutting off nations of men from the connexion which a common humanity gives, with the sacrifice of its redemption. On the contrary, the family of man is lineally descended from one original pair, and there is enough in the history of the past, as well as of the present, to illustrate the proposition and to maintain its truthfulness.

We may adduce, in the first place, the organisation of man, as a proof of the unity of the race; and, secondly, his *life* or inner nature. We believe that there can be no objection urged against the admission of what seems to be a self-evident fact, that the organ through which the inner man, or the spirit, holds communion with the world without, is the brain—that curious mass of pulpy neurine, with its blood-vessels and web of tissue, which is so admirably packed in the bone case of the skull. The essential man, through this organ—as through a lens—looks out upon the worlds of matter and spirit, and reads from its photographic surface those impressions which may come from without; while, by his consciousness—his reason—he brings forth thoughts, and manifests them through the instruments of sense and thought; all which may have been enregistered within. But this organ, like every other organic instrument, is developed by the proper discharge of its functions; and, like any other vitalised mechanism, will display those qualities best which it has most cultivated. Is the brain less admirably fitted for the discharge of its functions than the hand, beautiful and exquisitely formed as that instrument is, for the performance of its functions and offices? On the contrary, it is admitted that the intellectual and moral conditions of mankind are in accordance with the degrees of perfection to which the brain is developed, and in proportion to the exercise which the instrument undergoes is its increase in *power* and size. This is particularly noticed in the case of idiots, who, although possessing a degraded brain, nevertheless, by education, have their condition raised, and in some instances perfectly developed, affording also strong evidence of the independence of mind; for, from the lowest state of human developement, the creature may be raised to a higher; while, in the chimpanzee and ape, no amount of education can bestow the gift of reason, as we shall presently shew.

It is not yet a quarter of a century since Great Britain liberated from slavery a portion of the human family, which for ages, even in their own land, lived under most savage bondage, and yet no unprejudiced mind can refuse to acknowledge the rapid change which is passing over the African race settled in the West Indian islands. Education has only been partially accepted by them, or rather but lately generally introduced; and it is only among any considerable number of the rising generation that it is upon a large scale acting. Still a number of the last or present adult population have been educated, and from their ranks may be taken men as intelligent and well-informed as are to be found in general society in this country; and a few in the senate and in the professions, are deservedly esteemed. To one who visits the islands after an absence of some years, the changes in physiognomy and in the cranium are marked and evident; and, taking the people of the island of Barbadoes as illustrative, it may safely be affirmed that the truly African cast of head and face is becoming more and more obliterated. As these people ascend to higher forms of character, both moral and intellectual, so do the anterior parts of the head and the projecting lower jaw become less palpable; so that, in very many of the better class of black men, the European type is approximated. There are influences at work, no doubt, besides education, which in these, as in every other race, bring about improvement, and one of the principal of these is an absence of that complete isolation of classes, which is one of the greatest barriers to improvement in the tribal families of man settled in Asia, Africa, and North and South America. The constant admixture of the same blood and *mind*, ages of education in the same evil habits, have had their legitimate influence on these wild races of men; but the African in the West Indies, under the influence of European civilisation, and by an infusion of European blood, has been and is very materially improved, and should the same causes continue in operation, there can be no doubt but that in a comparatively short time a radical change will be effected. Mr. Squier remarks, that the Indian or aboriginal element preponderates in the population of Central America. The population of Honduras forms no exception to this remark; and in some districts of the state, it is difficult to say if the whites have assimilated most to the Indians, or the Indians to the whites. So will it be in the West Indies; and, from the disproportion of numbers, it is more than probable that some time will elapse ere a mixed race will be established, partaking of the properties of the two families which are now existing separately. It is evident that continued education, coupled with a superior mental conformation, are also influential in improving the standard of character in a people, and, *vice versa*, an intermixture of bad qualities, certain to produce a vicious influence. The older races of Europe, and portions of Asia, afford evidence of the former, while the Carib race and its mixture with African blood, is a standing evidence of the latter. In each and in all these instances, it is the "mind" of man in action, influencing and directing his very physical conformation. The reason degrading or elevating the body, in proportion to its state; and isolated people as a rule, degenerate, and are displaced by the more aggressive and intelligent. Dr. Latham illustrates this with his usual skill: after an account of the existing groups in Europe, he adds, "the displacements effected by the different European populations, one with another, have been numerous. See how the Saxons overran England; the Romans, Spain and Gaul. How do we know that some small stock was not annihilated here? History, it may be said, tells us the contrary. From history we learn that all the ancient Spaniards were allied to the ancestors of the Basques, all Gaul to those of the Britons, all England to those of the Welsh. Granted. But what does history tell us of Bavaria, Styria, the valley of the Po, or ancient Thrace? In all these parts the present population is known to be recent, and the older known next to not at all. The reconstruction of the original populations of such areas as these, is one of the highest problems in ethnology. To what did they belong? an existing stock more widely extended than now, or a fresh stock altogether? My own belief is, that the number of European stocks, for which there is an amount of evidence sufficient to make their extinction a reasonable doctrine, is two —two, and no more; and even with these, the doctrine of their extinction is only reasonable. The old Etruscans are the first of these; the Pelasgi, the second. I have used the word *extinction;* I must now qualify it, reminding the reader *that this very qualification* introduces a new and difficult subject. Extinction often means no more than the abolition of *the outward* and *visible* signs of ethnological difference. A negro marries a white: in the fourth, fifth, sixth or seventh generation, as the case may be, his descendant is, to all intents and purposes, a white man. Yet the negro blood is not extinguished; it exists, though in small proportions. Again, a Cornish man loses his native language, and speaks English as his mother tongue. Many generations before he did this, he differed from the Englishman in speech only. Is his British blood extinguished? No. The chief sign of it has been lost, that is all. So that stocks may intermix, and stocks may lose their characteristics."

Similar testimony to the diffusion of races, coupled with improvement generally, is abundantly gathered from Morton's Crania Americana, and a long list of *mixed races* constitute the sum of his observations; and when it is supposed that we are just going to alight on the nidus of some aboriginal stock or centre, we only learn that the oldest known race has been preceded by an older unknown one, which was itself preceded by—we know not what. Thus, in the cases of the Egyptian and Peruvian, Dr. Morton declares that they were both preceded by a different people, and, in the case of the latter, recognised the change to have been within a thousand years; and in the case of the Copts, he says, "The Copts are supposed by Niebuhr, Dennon, and others, to be the descendants of the ancient Egyptians; and it has often been observed that a strong resemblance may be traced between the Coptic visage, and that presented in the ancient mummies, paintings and statues: ***but it is in vain that we look for absolute identity in a country that has groaned in bondage for two thousand years.*** The Persians, the Greeks, the Romans, the Arabians, and the Turks, have successively held dominion in this fated valley, and subjected it in turn to every species of oppression. The Copts, therefore, can be at most but the degenerate remains, both physically and intellectually, of that mighty people who have claimed the admiration of all ages. The great mass of the present Egyptian population is composed of a mixed race of Copts and Arabs, who are called *Moslem-Egyptians*, or *Fellahs*. They are handsomer than the pure Copts." If these are facts applicable to the Egyptian family, what reason have we to withhold the application of parallel facts in the case of the African, both as regards his external conformation, and his mental state? Is continuous slavery and mental degradation to be urged as an effective argument of persistence of type in one case, and not in the other? Dr. Latham, in discussing the history of the British people, remarks, "In those tombs where the implements are most exclusively of stone, and where the other signs of antiquity correspond, the skulls are of unusually small capacity. In the next period they are larger. There are also some notable points of difference in the shape. How far is the introduction of metal instruments and of new arts a sign of the introduction of a fresh stock or variety of the human species?

How far, too, is the difference in the capacity of the skulls? How far the fact of the two changes coinciding?

The men who used instruments of bronze were Kelts; the men who eked out their existence with nothing better than adzes and arrow-heads of stone, were other than Keltic. They were ante-Keltic aborigines, whom a Keltic migration annihilated and superseded. Such is the widely-spread doctrine. Yet it is doubtful whether the premises bear out the inference; admitting that there is a difference in the size and shape of the skulls, it by no means follows that a difference of stock is the only way of accounting for it. Improved implements, taken by themselves, merely denote either a progress in the arts, or, what is more likely, some new commercial relations. From analogy, as well as from the facts of history, we rather incline to the belief that the improvement was effected by migration; but be this as it may, there are numerous instances to prove not only improvement or change of cranium with corresponding peculiarity of employment, but also to shew the same or like changes consequent on an intermixture of blood. These circumstances alone are enough to upset the dogma of those who ascribe hybridity to the offspring of two most remote families, and with a little trouble positive evidence could be adduced to contradict the assertion altogether. Morton, again, in numerous passages, refutes the position, and, as an example, we may take the following: "In the immediate vicinity of Mount Atlas the *distinctions* of race are often altogether confounded, owing to the proximity of negro tribes. Thus, the Tibboos are nearly black, and have long wiry hair—intermediate between that of the Tuarick and the negro; yet their features are good, and their forms delicately and even beautifully moulded." In Hayti or St. Domingo, the mulatto are a class, and maintain their numbers; and, in the West India islands, they are an advancing and intelligent people, raising themselves rapidly to the best and highest positions. Surely, then, if the mind of man acts through a material organ, it is not wonderful to find the cranium undergoing a change of form in correspondence with the higher or lower estimates of the scale of reason.

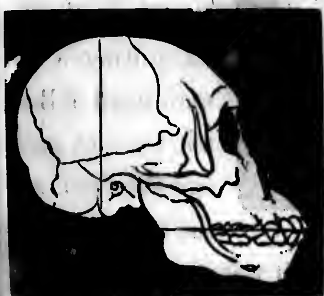
Man, as part of the plan of creation, is in his body allied to creatures below him, but yet is distinct and peculiar. A comparison of the skeletons of the chimpanzee and man, will shew the decided differences which exist between them; a creature, no doubt, Agassiz would consider, his prophetic type; an animal approaching him in some of his great characteristics, but yet placed at a decided interval from even his lowest lines; and when his mental endowments are considered, the gap is widened considerably, for it is not in any one animal that we discover approaches to him, in some wondrous instinctive qualities, but

CHIMPANZEE.

the manifestation is in several, and in some low in the scale. Although the chimpanzee, in its organisation, bears a striking resemblance to man, it is separated from him decidedly, as the accurate investigations of modern anatomists sufficiently prove. Tyson, Camper, Blumenbach, Cuvier, Lawrence, and especially Owen, have set that question at rest. "Certain modifications," observes the last-mentioned philosopher, "in the form of the human pelvis, have been observed to accompany the different forms of the cranium which characterise the different races of mankind; but there is nothing in the form of the pelvis of the Australian or negro, which *tends to diminish* the wide hiatus that separates the bimanous from the quadrumanous type of structure, in regard to this part of the skeleton. Observation has not yet shewn that the pelvis of the ourang, in a state of captivity, undergoes any change approximating it towards the peculiar form which the same part presents in the human subject. The idea that the iliac bones would become expanded and curved forwards,

HUMAN SKELETON.

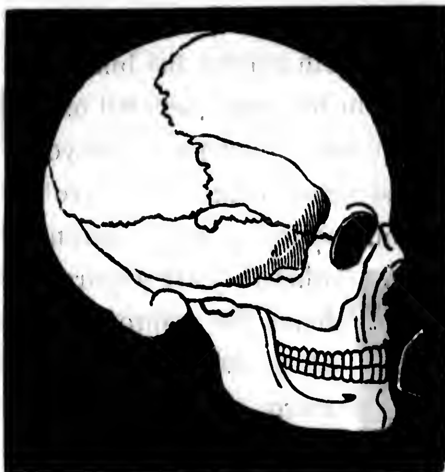
from the pressure of the superincumbent viscera, consequent on habitual attempts at progression on the lower extremities, is merely speculative. Those features of the cranium of the ourangs which stamp the character of the irrational brute most strongly upon their frame, are, however, of a kind, and the result of a law, *originally* impressed upon the species, which cannot be supposed *to be modified under any circumstances*, or *during any lapse of time*; for what external influence, operating upon and around the animal, can possibly modify in its offspring the forms, or alter the size of the deeply-seated germs of the permanent teeth? They exist before the animal is born; and let him improve his thinking faculties as he may, they must, in obedience to an irresistible law, pass through the phases of their developement, and induce those remarkable changes in the maxillary portions of the skull, which give to the adult ourangs a more bestial form and expression of head, than many of the inferior simiæ present. It is true that, in the human subject, the cranium varies in its relative proportions to the face in different tribes, *according to the degree of civilisation* and *cerebral developement* which they attain; and that in the more debased Ethiopian varieties and Papuans, the skull makes some approximation to the quadrumanous proportions: but in these cases, as well as when the cranium is distorted by artificial means or by congenital malformation, it is always accompanied by a form of the jaws, and by a disposition and proportions of the the teeth, which afford unfailing and impassable generic distinctions between man and the ape. To place this proposition in the most unexceptionable light, we have selected the cranium of a human idiot, in whom nature may be said to have performed for us the experiment of arresting the developement of the brain almost exactly at the size which it attains in the chimpanzee, and where the intellectual faculties were scarcely more developed; yet no anatomist would hesitate in at once referring this cranium to the human species. A detailed comparison with the cranium of the chimpanzee, or ourang, shews that all those characters are retained in the idiot's skull, which constitute the differential features of the human structure. The cranial cavity extends downwards below the level of the glenoid articulatory surfaces. The nasal bones are two in number, and prominent; the jaws and teeth exhibit the bimanous characters as strongly as in the most elevated of the human race. The cuspidate do not project beyond the contiguous teeth, and consequently there are no interruptions in the dental series, as in the ourangs, when they are required to lodge the disproportionate crowns of the canine teeth. No such discrepancies are discovered in man; it is impossible to draw such distinctions between the several varieties, as will enable the naturalist to declare that no such relationship or continuous connexion exists between them. As Prof. Owen remarks, their crania differ in proportion to their intellectual dif-



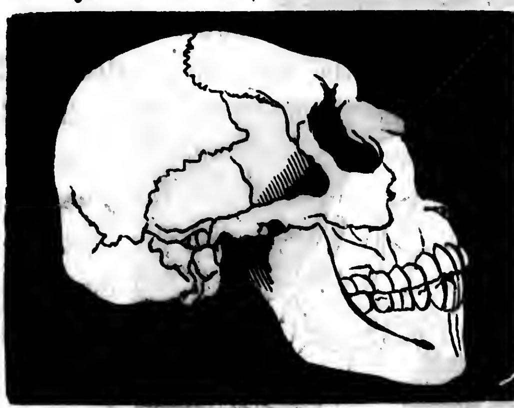
CHIMPANZEE.

OURANG.

ferences, and are certainly not greater or more characteristic than are the varieties of crania in the same nation; if we compare, for instance, the crania of men of one race, not only of varying intellectual states, but of moral states, do we not also find the most decided differences? Take for instance the illustrative sketches: the one exhibiting a human head of British type of average intellect, and the other the idiot alluded to by Mr. Owen; is it not evident in these



HUMAN SKULL.



IDIOT.

extreme cases that the cause of difference is not fundamental, but accidental from arrest of developement? Just so in the case of the uneducated man the varieties are begotten by cultivation of certain dispositions and propensities, to the neglect of others. In Dr. Combe's work, we have most satisfactory evidence of this, in the conformation of the skulls of men distinguished for some peculiar trait of character; and although association and contact with a higher civilisation must have had some effect on the whole character, yet in each case no doubt through neglected education, or want of education altogether, a deteriorating effect on the developement of the organ of the mind was the consequence. The above wood-cut represents the head of a crafty and depraved murderer, in whom it is well seen how badly developed are the anterior portions of the brain, while the projecting cheek bones and massive lower jaw, the width of cranium, from cheek bones or floor of orbit, to the occipital protruberance, and the depth of head from the depression or growth downwards of the floor of the occiput, give to the man a very animal appearance. Contrast, again, the diagrams illustrating the peculiar conformation of the heads of a French soldier and a girl,

ARTHUR SPRY.

whose characters are in strong contrast, and which are employed by Dr. Combe to shew the charac-

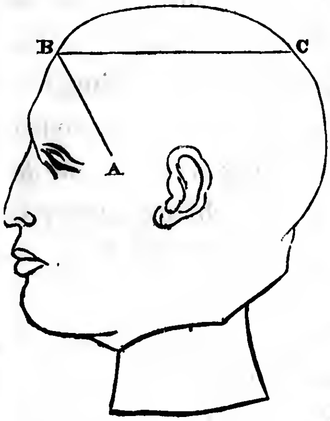
FRENCH SOLDIER.

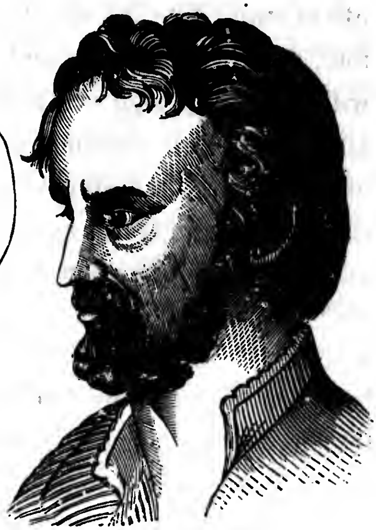
GIRL.

teristic differences between the English and French soldier. The French, under the influence of large combativeness and moderate cautiousness, make the most lively and spirited attacks; but, if steadfastly resisted, their ardour abates, and from deficiency in firmness, yield

INDIAN CHILD'S SKULL.

to adversity. The British advance to the assault with coolness and determination, and, although repulsed, are not discomfited. In the soldier, the convexity of the base of the occiput is decided; in the girl, it is moderate; in the skull of the Indian child, it is more marked, and shews how quickly the animal passions are developed, while the mental are merely retaining their rudimentary state, but which were equally developed with the other parts; the forehead has not receded yet. Again, is there a stronger contrast between the heads of a



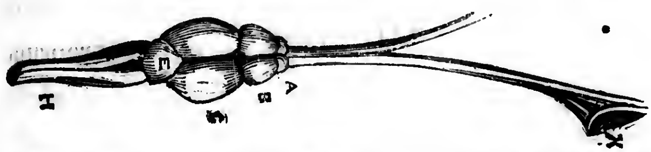


HARE. MELANCTHON.

civilised European and a highly intelligent North American Indian, than there is between the portraits of Hare, the brutal, cold-blooded assassin, and the holy-minded, resolute Melancthon and an Indian —such as Red-Jacket or Brant? Which of the two skulls is most widely separated in point of those qualities which give dignity and grace to the human character; and is it not true that in both the Indian and christian there is an approximation to cerebral conformity? while the British murderer is degraded to a savage type of existence.

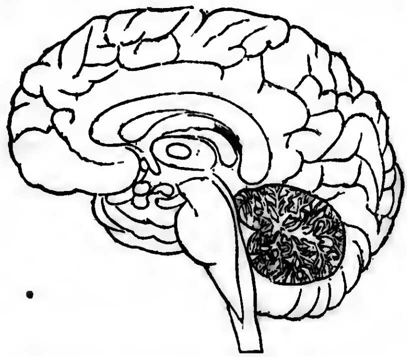
The brain is a mighty instrument, variously adapted to, and moving but in response to the intelligent will; and the will, traversing the electric threads of life, sends its mandates from its imperial throne, and conveys them to the most distant members. The life of man—like the life of all below him—is, therefore, a highly differentiated life. The organ of the will is step by step evolved in more complex form, associated with more complex arrangement of faculties, until at length, in fulfilment of the plan of creation, to the instinctive qualities of the being are added in the man those ennobling powers, by which through reason the spirit holds converse with its God. This being so, we should expect to find that, wherever mankind has been for any time settled in one place, or where they have been separated into isolated groups, varieties in the developement of the head or skull, which shall indicate in some marked manner the special attributes which such isolation may have brought out, will be manifested. A recent writer, Prof. Meigs, observes, "If the construction of each and every part of the fabric is in harmony with, and to a certain extent represented in that of all the other parts, as the laws of the philosophico-transcendental anatomy seem firmly to have established; it will be evident that the cranium is the index—so to speak—of the entire economy: for the relation between the cranium on the one hand, and the face, thorax, and abdominal organs, respectively, on the other, or, in other words, between the *cerebral* or intellectual lobes of the brain and the sensory ganglia and nerves, is the relation of *mental powers* to *animal* propensities; and *exactly* upon this relation depends the nature and character of the individual man, and the family group to which he necessarily belongs." That the brain is developed in the various classes of animals in accordance with their special requirements, is admitted by most anatomists and physiologists. Prof. Carpenter observes, "That the cerebrum varies in different classes and orders of vertebrata, not merely in proportional size, but also in the relative developement of its anterior, middle, and posterior lobes. The cerebrum of the oviparous vertebrata is *not* a minature representative of that of man as a whole, but only of his anterior lobes; as is sufficienfly obvious from an examination of its connexion with other parts, and from the absence of any commissural connexions between its two hemispheres, than those which are afforded by the sensory ganglia. It is in the implacental mammals that we find the first rudiment of the middle lobe of the cerebrum, and of the proper intercerebral commissure—the corpus callosum; and even in the rodents, this is but very imperfectly developed. As we ascend the mammalian series, we find the cerebrum becoming more and more elongated posteriorly, by the developement of the middle lobes, and the intercerebral commissure becomes more complete: but we must ascend as high as the carnivora before we find the least vestige of the *posterior* lobes; and the rudiment which these possess, and which is enlarged in the quadrumana, only attains its full developement in man, in whom alone the posterior lobes extend so far backwards as to cover completely the cerebellum. The attention which has yet been given to this department of the enquiry, has not hitherto done more than confirm the statement made with regard to the general correspondence between the developement of the cerebrum, and the manifestation of intelligence; very decided evidence of which is furnished by the great *enlargement* of cerebrum, and the corresponding alteration in the form of the crania which present themselves in those races of dogs most distinguished for their educability, when compared with those whose condition approximates most closely to what was probably their original state of wildness. These facts are borne out by observation on the human species. When the cerebrum is fully developed, it offers innumerable diversities of form and size among various individuals; and there are *as many diversities of character*. That a cerebrum which is greatly under the average size is incapable of performing its proper functions, and that the possessor of it must necessarily be more or less idiotic, there can be no reasonable doubt; on the other hand, that a well developed cerebrum is found to exist in persons who have made themselves conspicuous in the world in virtue of their intellectual achievements, may be stated as a proposition of equal generality. In these opposite cases we witness most distinctly the antagonism between the *instinctive* and voluntary powers. Those unfortunate beings in whom the cerebrum is but little developed, are guided almost solely by their instinctive tendencies; which frequently manifest themselves with a degree of strength that would not have been supposed to exist, and occasionally new instincts present themselves of which the human being is ordinarily regarded as destitute. On the other hand, those who have obtained most influence over the *understandings* of others have always been large-brained persons, of strong intellectual and volitional powers, whose *emotional* tendencies have been subordinated to the *reason* and *will*, and who have devoted their whole energy to the particular objects of their pursuit. It is very different with those who are actuated by what is ordinarily termed *genius*, and whose influence is rather upon the *feelings* and intuitions than upon the understandings of others. Such persons are often very deficient in the power even of comprehending the ordinary affairs of life; and, still more commonly, they shew an extreme want of judgment in the management of them, *being under the immediate influence* of their *passions* and *emotions*, which they do not endeavour sufficiently to control by their intelligent will."

Prof. Carpenter is, we believe, entirely entitled to the merit of making these important distinctions, and we beg to direct special attention to the doctrine which he advances with reference to the actions of the three several portions of the brain, and which he undoubtedly was the very first to propound. From a careful survey of the field of comparative anatomy, Dr. Carpenter has very properly arrived at the conclusion that the brain of man—the most complex in the whole scale of animal life—possessed certain elements which were not necessary to the classes below him; after a careful analytical enquiry, he has deduced the rational inference now received as a legitimate truth, that to the superadded parts were to be assigned special functions. We find from comparative anatomy, as well as from diseased conditions of the brain, that the organ is divided into several parts, the seats of severally distinct classes of phenomena. Thus, commencing with th se, we have in the cerebral system of vertebrata, 1st. A system of ganglia subservient to the reflex action of the organs of *locomotion*, and corresponding with the chain of pedal or locomotive ganglia, that make up the chief part of the ventral cord of the articulata; in this system the grey or vesicular matter forms one continuous tract, which occupies the interior of the spinal cord. 2nd. A ganglionic centre for the *movements* of respiration, and another for those of mastication and deglutition; these, with part of the preceding, make up the proper substance of the medulla oblongata. 3rd. A series of ganglia in immediate connexion with the organs of *special* sense; these are situated *within* the cranium, at the anterior extremity of the medulla oblongata; and, in the *lowest* vertebrata, they constitute by far the *largest* portion of the entire encephalon. 4. The cerebellum, which is a sort of offshoot from the upper extremity of the medulla oblongata, lying behind the preceding. 5. The cerebral hemispheres—a pair of ganglionic masses which lie upon the ganglia of *special sense*, capping them over more or less completely, according to their relative developement. Of these, the first *three* may be considered as constituting the *automatonic* portion of the nervous centres, whilst the cerebrum is certainly the original source of all *voluntary* movements; and the cerebellum seems to contribute to the *adjustment* and *combination* of the individual acts by which the directions of the will are worked out, through the instrumentality of the automatic apparatus. Now the chain of sensory ganglia, which forms nearly the entire encephalon of fishes, but which is overlaid and obscured in man



Brain of the pike. A Olfactory ganglion. B Hemispherical ganglion. C Optic ganglion. E Cerebellum. H Spinal cord. X The olfactory nerve penetrating the cribriform plate of ethmoid bone, without any *bulbous* enlargement.

and in the higher vertebrata by the relatively enormous developement of the cerebrum, may be regarded as constituting the true *sensorium;* that is, as the seat of *consciousness*, to which impressions made upon the nerves of sense are carried, and through which the individual is rendered cognisant of them. There is abundant evidence that this endowment does not exist in the locomotive, stomato-gastric, or respiratory ganglia, of which the spinal cord and the principal part of the medulla oblongata are made up; whilst, on the other hand, there is adequate proof that the presence of a cerebrum is not necessary to its possession. Without presuming, says Prof. Carpenter, to affirm positively what cannot be proved, it may be stated as a probable inference, from physiological facts and from psychological evidence, that the sensory ganglia constitute the seat of consciousness, not merely for impressions of the organs of sense, but also for changes in the cortical substance of the cerebrum; so that until the latter have reacted downwards on the *sensorium*, we have no consciousness either of the formation of ideas or of any intellectual process of which these may be the subjects. Ideas, emotions, intellectual operations, &c., have of late been frequently designated as "states of consciousness," and this psychological description



CEREBRUM AND SENSORY GANGLIA.

of them is in full harmony with the physiological account given of the material conditions under which they respectively occur.

There can, therefore, be no doubt that the mechanism of the mind is exactly adapted to each condition, and that Leuret is correct when he alleges "that the number, form, arrangements, and relations of the cerebral convolutions are not formed at hazard: every family of animals has a brain formed in a determinate manner. How can we believe that the most important organ in the economy, that by which the manifestations of intelligence operate, to which is attributed the *instincts and passions* and the *intelligence* and *reasoning power*, has not a fixed organisation, and as invariable as that of other parts?" But if Prof. Carpenter has established the claim of the large ganglionic central masses to be the sensorium proper, then have we to claim for them an equal degree of importance in determining the character of the individual, and the shape of the cranium; and we shall find that in three directions especially would the relative or absolute preponderance of these masses influence the shape of the skull. In Dr. Pritchard's admirable work, we find there crania which we conceive do illustrate the point well;* by comparing these skulls with each other, and taking the Greek as the proper type, we cannot fail to discover that the increased develope-

* Compare European, African, and other skulls.

ment of particular portions is dependent, evidently, on the developement of the cerebral masses occupying the position of the sensory ganglia, with corresponding diminution of the cerebral anterior lobes, and, in some instances, of shortening of the posterior lobes to a very appreciable extent, and enlargement of the cerebellum and posterior lobes, giving a great convexity and breadth to the occiput. Now, before applying our observations to the various families of man—using the term in its familiar sense—let us see what precise series of mental operations Prof. Carpenter supposes to act through the ganglia in question. He thus explains, "The sensory ganglia collectively constituting the sensorium, may be regarded as the most essential part of the encephalon, since we find them fully developed in animals which scarcely possess a rudimentary cerebrum, and presenting the same relative condition to the latter in the early embryo of man. They directly receive the nerves proceeding from the organs of special sense, each pair of which has its own ganglionic centre; and they receive also, through (the so-called) crura cerebri, the nerves of 'common sensation,' whose ganglionic centre appears to lie in the thalami optici. They give off a large number of motor fibres, which, descending through the crura cerebri, are distributed with the fibres proceeding from the spinal ganglia, through the various motor trunks, to the muscular system generally. On the other hand, by one set of radiating fibres of the cerebral substance, they transmit sensorial impressions upwards to the vesicular surface of the hemispheres; whilst conversely, by descending fibres, they receive the impressions transmitted downwards from the cerebral ganglia, and they thus constitute the medium by which alone the cerebrum communicates with the organs of sense on the one hand, and the muscular apparatus on the other. The sensory ganglia must be regarded as collectively forming the organ through whose instrumentality the mind is rendered conscious of impressions made on the organs of sense; and reasons have been advanced for the belief that it also serves as the instrument whereby the consciousness is affected by cerebral changes, which, in so far as they take place independently of the will, are the cause and not the consequence of mental activity. There is no reason to think that the sensorium has in itself any higher function than that of impressing the consciousness of the individual; this impression on the consciousness when made by an external impression, operating through the sensory nerves, is that which is known as *sensation;* but when produced by *cerebral* changes, it constitutes ideation." We may therefore conclude that, where the animal or man receives his impressions through the sense-organs and less through the cerebrum, there will be the superior automatic and animal predominance of the qualities of mind.

IMAGE EVALUATION
TEST TARGET (MT-3)

6"

It is not a little singular that Dr. Pritchard should have used this peculiar construction of the brain as an argument to shew how the skull may become modified by preponderance of one or the other portions of the brain: he says, "The greater relative developement of the jaws and zygomatic bones, and of the bones of the face altogether, in comparison with the size of the brain, indicates in the pyramidal and prognathous skulls *a more ample extension of the organs subservient to sensation and the animal faculties.*" If we contrast the skulls in Combe's illustrations, we shall find the characteristic difference here referred to: thus, in the skull of the Greek, we find that lines drawn in accordance with the principle laid down by Mr. Combe, give us a remarkable developement of the anterior and coronal portions of the brain, with a sufficient developement of the upper portion of the posterior part of the cerebral lobes, thus giving a preponderance to those parts of the encephalon, which are the instruments of the moral, intellectual, or reflective faculties of the mind. Here we find the face and lower jaw *orthognathic*, (*orthos*, upright, and *gnathos*, jaw). In the negro proper, and in the affiliated varieties—as the Galla and some of the Nilotic—the moral and intellectual faculties are less developed, while, at the same time, the animal and sensory regions are highly developed, although there are many characteristic qualities in the negro mind, and therefore in his cranium, that place him above the North American Indian. The annexed wood-cut affords an apt illustration, and exhibits the peculiar projection of the lower and upper jaws and recession of forehead, with the large developement of sensory ganglia : we thus have the prognathous (*pro*, forwards, and *gnathos*, jaw) character. Again, by comparing the skulls of the wretched woman Gottfried, a noted murderer, and that of the head of the negro Eustache, we shall find that, in proportion to the preponderance of sensory, or moral and intellectual organs, so is the character of the individual or nation. If we examine the inferior animals, the same facts are apparent, as regards their faculties.

NEGRO.

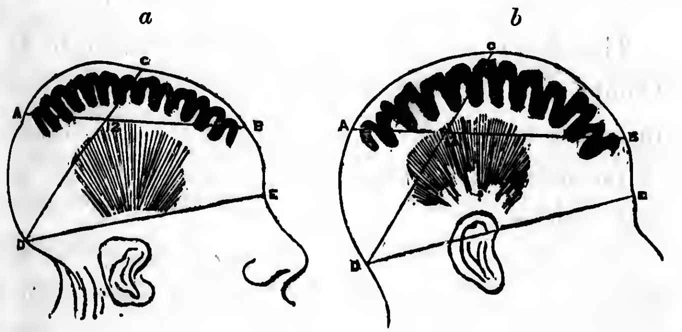
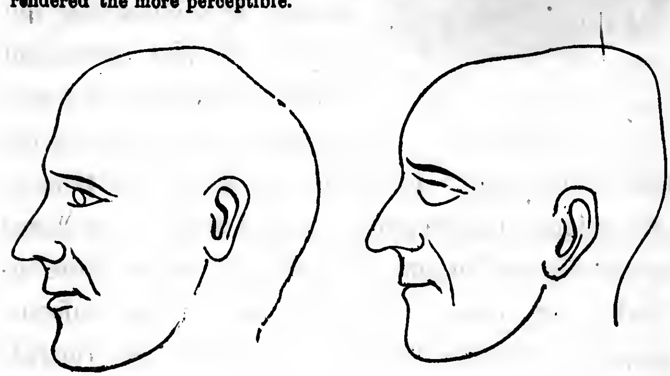


Fig. *a* represents the head of Gesche Margarethe Gottfried, a cruel and treacherous female, who was executed, at Bremen, in 1828, for poisoning, in cold blood, during a succession of years, both her parents, her three children, her first and second husbands, and about six other individuals. The line A B commences at the organ of causality, B, and passes through the middle of cautiousness, 12. These points are in general sufficiently distinguishable on the skull, and the line can easily be traced. The convolutions lying above the line A B must have been shallow and small, compared with those below, which are devoted to the animal propensities.

Fig. *b* is a sketch of the head of a negro named Eustache, who was as much distinguished for high morality and practical benevolence as Gottfried was for deficiency of these qualities. During the massacre of the whites by the negroes in St. Domingo, Eustache, while in the capacity of a slave, saved, by his address, courage, and devotion, the lives of his master, and upwards of 400 other whites, at the daily risk of his own safety. The line A B is drawn from causality, B, through cautiousness, 12; and the great size of the convolutions of the moral sentiments may be estimated from the space lying between that line and the top of the head C.

Both of the sketches are taken from busts, and the convolutions are drawn suppositively for the sake of illustration. The depth of the convolutions, in both cuts, is greater than in nature, that the contrast may be rendered the more perceptible.



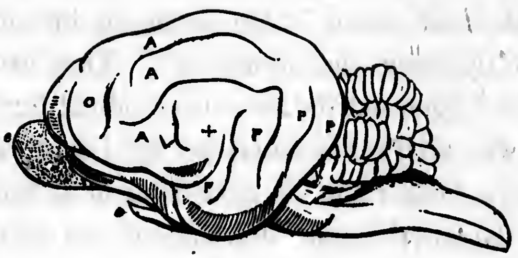
FRANCOIS CORDONNIER. MR. A——.

The above represent casts of heads taken by Dr. Combe, and afford striking evidence of the difference in heads, which accord with peculiar characteristics in the individual, more in the intellectual than animal regions.

Prof. Owen, in a paper communicated to the Zoological Society as far back as 1833, began a classification of the convolutions of the brain. His paper was simply entitled, "The Anatomy of the Cheetah, *Felis jubata*." He continued his observations to the feline and canine race. They are very clear, and point out the same longitudinal furrowing which was afterwards described by Leuret, as will be shewn further on. I have thought it better to follow the latter, as his descriptions are more extended, and quite confirm the observations of Prof. Owen, who observes, that the constancy manifested in the disposition of the convolutions, as to their form, extent, and symmetrical arrangement, argues strongly in favour of the conclusion that the folding of the hemispherical substance in the progress of developement follows a determinate law. A classification of animals in relation to their convolutions, will be found to accord with the extent of their intelligence; animals may be divided into groups, in accordance with the form of their convolutions.

The *first group* includes animals taken from different families, viz., the cheiroptera or bats, the insectivora, the marsupiata, the monotremata, and especially the rodentia. They correspond, as regards the absence of convolutions, to those birds which have but little intelligence.

The *carnivora*.—The number of ganglia and commissures constituting the encephalon of these animals is the same in all. There is no great peculiarity as regards their relative size. In the common cat (see wood-cut), the olfactory ganglia (*e*), as we might



Side view of the brain of the common cat. E Olfactory ganglia. O Optic nerve. A A A Anterior portion of the longitudinal convolutions. P P P Posterior of ditto. X Union of the two. O Orbital convolution.

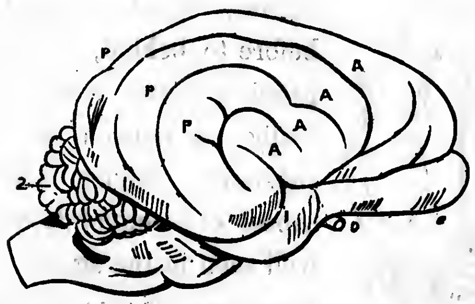
expect, are enormous. The hippocampal lobes are also large. The hemispheres cover the optic tubercles, and partly overlap the cerebellum. The hemisperical ganglion is much convoluted. The convolutions are described further on. The anterior and posterior quadrigeminal bodies are of nearly equal size, the anterior being rather the longest from before backwards. In the lion, the posterior, though smaller in longitudinal diameter, are broader, and rise above the level of the anterior pair. In the seal the olfactory ganglia are small, but not absent, as in the cetacea, though the form of the brain resembles in its roundness that of these creatures. The hemispheres do not entirely cover the cerebellum, which is large, especially its lateral lobes. The corpora olivaria maintain the same central position as in the porpoise, but they do not project on the surface. The *corpus trapezoidum*, that oblong portion of the medulla oblongata running transversely inferior and parallel to the pons varolii, between the fibres of which facial and auditory nerves emerge, is of remarkable size in all genus *felis*.

In the second group there are still no convolutions, but there are depressions which announce, as it were, their approach. The animals which compose this group are from the rodentia, the insectivora, and the marsupiata. Besides the fissura sylvii, which is here more prominent than in the first group, there are depressions upon the cerebral lobe which have a certain regularity, as may be seen in the examination of the brain of the hare and agouti.

Upper surface of the brain of the agouti. Slight tracing of the longitudinal convolutions. A Olfactory ganglia. B Hemispherical ganglia. E Cerebellum. H spinal cord.

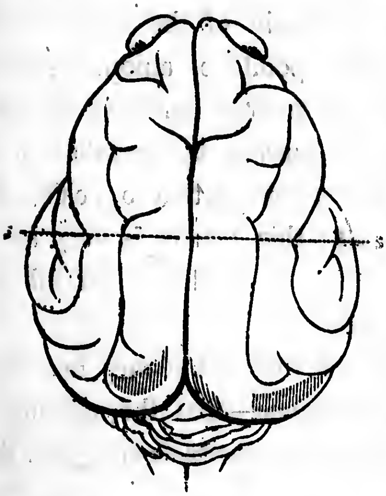
On each side of the median furrow, which extends from before to behind, we see a parallel furrow which circumscribes a portion of cerebral substance, having almost the aspect of a convolution : this is well seen in the agouti. In the beaver we see some furrows less prolonged but more deep, having the same direction as those in the hare and agouti. Gall and Spurzheim were in error when they stated that the number of convolutions is in relation to the volume of the brain ; for instance, in the brain of the ferret there are five convolutions very distinct, three external, one internal, an anterior or supra-orbital; yet the brain is not equal to that of the squirrel, which is without convolutions or furrows, and it is much inferior to that of the hare, of the porcupine, of the paca, agouti, beaver, &c. These latter have a brain more voluminous than the ferret and the polecat. Nevertheless, it is generally true that those species of animals which have the most voluminous brain, have also the convolutions and undulations most numerous and varied.

M. Leuret illustrates his views regarding the cerebral convolutions, by a demonstration of the convolutions of the brain of the fox, exhibiting the external



Brain of the fox. E Olfactory ganglia. A Optic nerve. O Orbital convolution. A A A Anterior ditto. P P P Posterior ditto. 1 2 Cerebellum.

face of the right hemisphere of the brain: (s) marks a deep furrow, passing obliquely upwards and backwards—the fissura sylvii. There is a rounded body surrounding this fissure—this is the first convolution; a second, third, and fourth, are placed one above the other, making four convolutions; before these, placed in front, there is a fifth, (o) the supra-orbital. The sixth, and last, (1) forms at the under part of the middle lobe the hippocampal convolution. If we compare this brain with that of the bear, we find that the fissura sylvii is larger, but there is the same proportion to the rest of the brain. Instead of their being four lateral convolutions, as in the fox, there are only three, though at first sight the brain appears more complicated. The succeeding wood-cut, representing the upper surface of the brain of the fox, shews the completion of the fourth convolution, of which the above shews the internal and posterior part.



Upper surface of the brain of the fox. s s Fissura sylvii.

The third group contains the fox, wolf, &c. The convolutions of the brain of the wolf are the same in number as those of the fox, only there are more numerous depressions, and a very prolonged furrow upon the third external convolution, in the spot where in the fox there is only a rudiment of a depression. Leuret states that he has compared the brains of dogs of different species, and he has always found the same type, the same convolutions, without any difference but in the number of the depressions, and extent of the undulations ; this difference corresponds to the volume of the brain.

Fourth group.—All animals of the genus cat and hyæna are comprised in this group. As in the preceding group, the smaller the brain, the fewer the convolutions and depressions. There are many essential differences with regard to the cerebral convolutions between the fox tribe, which includes the dogs, and wolves, and the cats. In these latter we find four external longitudinal convolutions, one internal, and one supra-orbital. But, contrary to the arrangement in the brain of the foxes, these convolutions have many points of union, which, I believe, arises from the greater length of the ganglion requiring it to be pushed up together in its long axis, at the point of convolution opposite the fissura sylvii in the cat ; this furrow is very much developed in the panther, in the lion, and all the large species of this genus.

Fifth group.—They are varied, but they have this common point of resemblance—that the number is only five, three external, one supra-orbital, and the fifth internal.

The civet forms a very natural and easy transition between the bears and the foxes. The genet forms a transition between the brain of the civet and that of the marten. In the coati there are but three external convolutions; the first is of unequal size in different parts of its extent; behind the fissura sylvii it is very much enlarged; above that fissure it recedes upon itself, and remains partly below the anterior portion of the second convolution. The same disposition is met with in the weazel, the marten, the otter, and the bear. The second convolution is in an inverse ratio to the first, being larger before than behind. The third convolution, simple and regular in the ferret, has in the polecat a fissure behind, which is replaced on the two sides. The coati has more depressions. Viewing the brain of the ferret, weazel, coati, badger, and polecat, above, a transverse fissure may be seen to cut the mesial fissure, like the letter V. The convolution in front of this fissure, which forms the anterior point of the brain, is a portion of the internal convolution, which, commencing at the hippocampal lobe, runs backwards, embraces the corpus callosum, and rises anteriorly to unite with the superior convolution. Above the orbit is the last convolution, the supra-orbital; it is furrowed for the olfactory commissure.

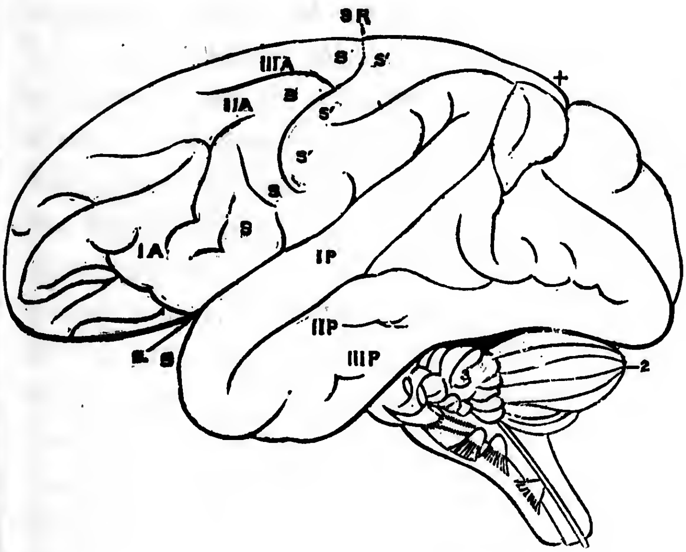
The brains of the fifth group form a sort of transition between the foxes and the sheep. The sixth group includes only the ichneumons. The seventh group includes the two-toed sloth, the ai or three-toed sloth, the African ant-eater, phascolomys or wombat, and the hyrax or coney. In none of the animals composing this group do we meet with a single transverse furrow. The eighth group includes the pteropus, or fox-like bat, kangaroo, orycteropus.

Ninth group.—The brain of the genus sheep, including the ruminantia, which form the ninth group, has in reality only four convolutions; one internal, one infra-orbital, two external, which have numerous divisions, some depressions, and a form very undulating. It is a sort of amplification of the brain of the orycteropus. The convolutions of this group, in their general aspect, do not resemble those of the foxes, cats, or bears; they have more analogy to the convolutions in the human brain. Viewed above, we observe the longitudinal foldings much doubled up, so as to produce many transverse folds. We cannot attempt to follow out all the minute varieties in the convolutions of the tenth, eleventh, and twelfth groups of M. Leuret, which include the pigs, the seals, and the cetacea, but proceed to the thirteenth group. With the exception of sub-orbital convolutions, the convolutions of the brain of animals below this group are all directed from before to behind—they traverse the brain longitudinally. Between these convolutions in many brains there are points of union, a sort of soldering or joint; they are found in the cat, bears, otter, sheep, &c. but all are parallel, none are placed transversely to the brain, cutting the longitudinal convolutions into two parts, and dividing them into *anterior* and *posterior convolutions*. This division of the longitudinal convolutions, this addition of new convolutions, is found only in the elephant, the apes, and in man.

Fourteenth group.--In the apes, and especially the monkeys, the convolutions are not so undulating and voluminous as in the elephant and whale; thus they appear at first sight to be further from man than the latter: but a little attentive observation soon dispels this illusion. The general form of the brain of the monkey, its developement behind, the extent and degree of inclination of the fissura sylvii, form a brain as an embryonic perfectioning of the

The above represents the internal surface of the right hemisphere of the Indian elephant. C C Corpus callosum. I I I I Internal convolution. This convolution, above and behind the corpus callosum, sends a prolongation X, which is united to the superior convolutions S S S S. Leuret states that he has never met with this disposition of the convolutions, except in man, the ape, and in the elephant. This portion cuts the antero-posterior convolutions into two portions, of which some are anterior and the others posterior. III P, III P Third posterior convolution. IV P, IV P Fourth posterior convolution. IV A Fourth anterior convolution. "Suppose," says Leuret, "that all the superior convolutions, S S S S, and the prolongation, X, of the internal convolution are obliterated, the fourth anterior convolution might be united to the fourth posterior convolution, the third to the third, and we should have one of the groups of convolutions of the brain of the ruminants and solipedes."

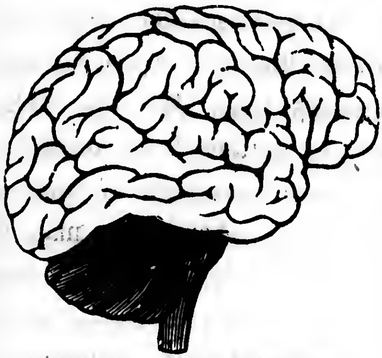
brain of man, whilst the brain of the elephant, and especially that of the whale, considered in their different relations, descend towards the form of the brain of other mammalia. The ape has three anterior convolutions, three posterior, two superior, one internal, and the supra-orbital convolutions, also corresponding to those in man. The orbital convolutions always exist; they are larger and better divided than in the inferior animals, but they do not shew the same regularity as the others. "The brain of the chimpanzee," says Mr. Owen, "in the relative proportions of the different parts, and the disposition of the convolutions, especially those of the posterior lobes, approaches nearest to the human brain; it differs chiefly in the flatness of the hemispheres, in the comparative shortness of the posterior, and in the narrowness of the anterior lobes." It also approaches nearer to the human brain than that of the other mammalia, in the absence of the corpus trapezoidum, which, I observe, exists in the brain of many of the apes, though I cannot affirm that the chimpanzee is the only exception." The number, form, arrangement, and relations of the cerebral convolutions,. says Leuret, are not formed at hazard: every family of animals has a brain formed in a determinate manner, and the difference of opinions on this subject arise from the want of attentive examination of a sufficient number of brains. Observation has thus shewn what strict induction had led us to conclude. How, indeed, can we believe, that the most important organ of the economy, that by which the manifestations of intelligence operate, to which is attributed the instincts and passions, has not a fixed organisation, and is invariable as that of other parts. Each group of brains has a type which is proper to it, and this type is especially manifested by the form of its convolu-



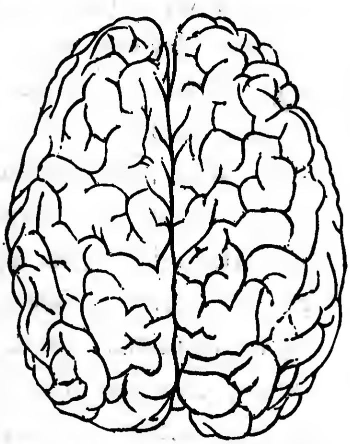
Left side of the brain of the baboon (*Singe Papio*), S S Fissure of sylvius, running obliquely from before backwards. S II Fissure of rolando. S S S, S' S' S' The two superior convolutions. I A, II A, III A First, second, and third anterior convolutions, arising all three from the same superior convolution. I P, II P, III P First, second, and third posterior convolutions. The first, long, isolated, and turned round above the fissura sylvii, and directed towards the first anterior convolution, from which it is separated by the lowest part of the superior convolutions. The second and third convolutions are carried above and behind the cerebellum, and are in part confounded one with the other. X Point of re-union and prolongation of the superior convolution, S' S' S', with the prolongation of the internal convolution. 2 Lateral lobe of the cerebellum. 3 Third lobe of the cerebellum, or *flocons*.

tions. In the foxes the divisions are clear and well marked; in the cats the divisions are less, but still the forms are fixed and very simple; in the bears and martens there is a tendency to another form, complete preservation of some convolutions, which I have called primitive, on account of their simplicity, and disposition of some of the others to unite and present undulations. In the next type, the fundamental separations are less numerous and of greater variety in their details for the different groups to which the wombat, kangaroo, roebuck, pig, seal, and whale belong. Next, as in the elephant, an entire addition to the general forms, with an infinite developement of details. In the ape, a still more perfect type, nearer to man, but incomplete and rudimentary. In each family, as a general rule, the more the brain increases, the more it divides, the more also it acquires undulations. The fox, the domestic cat, the weazel, the ferret, the roebuck, the peccary, each represents the first step of a scale, at the summit of which is the dog, the lion, the otter, the hyrax, and the boar. In its class the elephant is at the summit; but I know of no animal which can be placed at the opposite end. In its own class the lemur is very low, the ape very high, and man very far above the ape. However, there are some large brains which do not represent a perfect type of some small brains of the same class. Thus, that of the ox is not more perfect than that of the sheep;

that of the whale is not above that of the porpoise. Are there intermediate degrees between all these brains? Are there any forms of brain different from those that I have described? Observations more extended can alone resolve these questions, which are of the deepest interest for anatomy and psychology.



EXTERNAL FACE OF BRAIN.



SUPERIOR ASPECT OF BRAIN.

The annexed outlines of the internal and external aspects of the human brain will convey a tolerable idea of the superiority of its construction, over that of the animals below man in the scale of existence. We have not only a more deeply convoluted surface, but we have also the posterior lobes covering the cerebellum, and the middle lobes largely developed. It is pointed out by Prof. Owen as a remarkable feature in the geographical distribution of the quadrumana, that the peculiarly limited range of the ourangs and chimpanzees contrasts strikingly with the cosmopolitan range of man. The former appear inexorably bound to their localities by climatal influences regulating the assemblage of certain trees, and the production of certain fruits; and with all our care in artificially supplying these conditions, the healthiest specimens of ourang or chimpanzee, brought over in the vigour of youth, perish within a period never exceeding three years (and usually much less) in our climate. By what metamorphoses, he pertinently asks, has the alleged humanised chimpanzee or ourang been brought to endure all climates? The advocates of transmutation have failed to explain them. In man, the brain presents an ascensive step in developement, higher and more strongly marked than that by which the preceding sub-class was distinguished from the one below it; for not only do the cerebral hemispheres overlap the olfactory lobes and the cerebellum, but they extend in advance of the one and further back than the other; and their posterior developement is so marked, that anatomists have commonly assigned to that part the character and name of a third or "posterior lobe." The superficial grey matter of the cerebrum, through the number and depth of the convolutions, attains its maximum of extent in man; and the system of intercommunicating fibres, by which the various parts of the convoluted surface and the ganglionic centres covered in by the hemispheres are brought into relation with each other, is greatly augmented in complexity. The peculiar mental capabilities which are associated with this highest form of brain, and the possession of which constitutes the essence of man's immeasurable superiority to all other mammals, give an importance to his cerebral character which it is scarcely possible to over-estimate; and we are fully satisfied, therefore, of the correctness of Prof. Owen's view of his zoological relations, in making him the representative not merely of a distinct order, but of a distinct sub-class, for which he proposes the name *archencephala*, significant of the overruling superiority of his cerebral organisation.

CHAPTER II.

Physiology teaches us that, in accordance with the power and capacity of the mind, is the developement of the organ through which it communicates with the world and the world with it. It is however inferred from this, that the type of cranium, and therefore the type of mind, is fixed for certain primitive races, and that from these types there has been no departure. Thus, in tracing back the history of the world for nearly eight thousand years, it is alleged that on the earliest monuments the features of the primary races of mankind are found—the negro face being accurately depicted on the Egyptian monuments ; and it is concluded from this, that no change having taken place since in the negro, therefore his and all other permanent races, as they are called, were originally created at the centres where they are now found, and are not the lineal descendants of one pair.*

* The doctrine set forth by M. Agassiz is an exaggeration of a philosophic speculation, which has been met by Mr. Mansel's arguments, against an irrational conception of an abstract humanity—which subordinates the individual to the universal, the person to the species. If there is one dream, he says, of a godless philosophy, to which, beyond all others, every moment of our consciousness gives the lie, it is that which subordinates the individual to the universal, which deifies kinds and realises classification, which sees Being in generalisation and Appearance in limitation; which regards the living and conscious man as a wave on the ocean of the unconscious infinite, his life a momentary tossing to and fro on the shifting tide, his destiny to be swallowed up in the formless and boundless universe.

Yet there is and must be a sense in which we must admit the existence of human nature as the common property, a sense in which that human nature was depraved in all, as it has been re-constructed for all. We have endeavoured to shew that the inheritance of the flesh and inner nature is by continuous descent, by direct, unbroken, lineal progression, and in like manner the re-construction of that nature: and so it comes to pass that, From the depths of the human soul deep calleth to deep; there are ever issuing forth sympathetic actions which demand from us the recognition of a common principle of love, which teaches us to seek

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in the personality of Christ—the new Adam—we have that rock which contains the living water; the stream of life flowing only for those who, having been grafted into His body, readily and heartily receive Him as their only source of life. Humanity is drawn into Himself, that it may flow out again purified and cleansed for the in-dwelling of the Spirit of God; but inasmuch as the Second Man reclaims human nature through the sacrifice of Himself, it is by Sacramental union that we receive the gift of a regenerated nature, and are preserved by His strength imparted to us, from lapsing into eternal death. If we accept the doctrine of M. Agassiz, which plainly intimates that the human soul, or the spiritual man, being one and the same, has been clothed upon by differing kinds of human flesh; then we cannot understand the doctrine of a *fallen humanity*, or trace the relationship which runs through the family as human beings; but, on the contrary, the personality of each man being established, and his human origin being traced from one even as himself, we can understand how, in a sense, there is a common humanity through which all are bound together, and all reclaimed through the God-Man.

In another place Mr. Mansell adds, "If, on the one hand, the spiritual element within me, is merely dependent on the corporeal; if *myself* is a result of my bodily organisation, and may be resolved into the operation of system of material agents; why should I suppose it to be otherwise in the great world beyond me? If I, who deem myself a spirit distinct from and superior to matter, am but the product of that which I seem to rule; why may not all spiritual existence, if such there be, be dependent upon the constitution of the material universe? Or if, on the other hand, I am not a distinct substance, but a mode of the infinite—a shadow passing over the face of the universe; what is that universe which you would have me acknowledge a God? It is, says the pantheist, the one and the all. By no means; it is the many in which there is neither all nor one. You have taught me that within the little world of my own consciousness there is no relation between the one and the many; but that all is transient and accidental alike.

"One feature deserves especial notice, as common to both of those modes of consciousness which primarily exhibit our relation to God. In both we are compelled to regard ourselves *as persons related to a person*. In the feeling of dependence, however great it may be, the consciousness of *myself*, the dependent element, remains unextinguished; and, without that element, there could be no consciousness of relation at all. In the sense of moral obligation, I know myself as the agent on whom the law is binding; I am free to choose and to act, as a person whose principle of action is in himself." There can be no doubt that M. Agassiz destroys the doctrine of the Incarnation and Atonement as effected by the Son of Man, and substitutes a doctrine hard to be understood, and drives the mind into a credulous belief—to end in delusion. Differing, as we do, from Mr. Mansel, as to his notions of the Infinite, as applied under the dictates of revelation and the conscious mind, to the apprehension of a personal, self-existent, infinite Creator, we yet cannot fail to appreciate the full force of the arguments by which he shatters to fragments the false god which pure rationalism has created.

out and to heal the woes which may be corroding the life of our fellows. It is not the passive possession of virtue, or the sentiment of religion, which dignifies man; but it is the possession of all this, and its manifestation in intense action and vigour, which offers to us one of the most convincing proofs of the universality—the oneness of that nature which man enjoys. Contrary to all else in nature, man in his best estate, and under the best and highest influences, seeks by the sacrifice of his individuality to carry to his less fortunate brother the elements of the happiness which he has obtained. No obstacles check his course, no terrors affright him from his purpose; and whether it be to proclaim tidings of peace to the frozen north, or to the heated plains of Africa, the missionary of the Gospel is indomitable in his intent and humble in the discharge of his duty, as was the life of Him whose reign he proclaims. This unobtrusive warfare of light against darkness—of the spiritual against the carnal man—is not a whit less hazardous, and surely not less fraught with peril to the champion of the cross, than the noisy pomp and pretension which surround the turmoil of hostile hordes. It is human nature individually entering into contest with wide-spread corruption; it is individual effort contending with a multitude possessed of evil. Now, whence this sympathy; whence this inborn passion to do good to all men; this burning desire, which seizes and takes hold of the hearts of christian men, to turn to like principles those who, from ignorance of such things, are brutish and low? Convince mankind that there is no brotherhood, that all nations of the earth are not of one blood, and you take from them one of the best incentives to sympathy. But, fortunately, no false theories can displace this principle from the mind. "Let brotherly love continue," was the precept of old, as it is the precept now, and will be for ever; and it is because we have this fellowship within us, that we have a real bond of union drawing us together, so that the declaration, "He hath made of one blood all the nations of the earth," becomes convincingly fixed upon our minds, and we feel that to be true which nature and revelation both attest.

As the result of investigation into the anatomical peculiarities of the brain in the different classes of animals, we find that to each class is assigned a special adaptation of the nervous matter, and although the popular and thoroughly misapplied views of Gall and Spurzheim are incapable of verification, yet, as Prof. Carpenter clearly points out, the three grand divisions of the cerebral mass do minister to the intellectual, emotional, and sensory-motor powers proper to the life of man and animals below him. It is therefore true that, in proportion to the superior developement of the different portions of the organ of the mind, is the general shape and proportion of the cranium or case of the brain. In the most widely-differing portions of the human race we fail to detect any fundamental differences at all sufficient to constitute such transformations, as would suffice to sever the family into diverse races; and the more closely the history of fœtal developement is attended to, the more certain do Dr. Knox's opinions appear—that it is in the developement of the fœtus that we must look for those points of conformity or non-conformity which give evidence as to the diversity or oneness of families. As yet we have only observations made on, and deductions derived from the crania of adults; and, notwithstanding the great value of such collections, we believe them to be entirely insufficient to substantiate any claim for the effective division of man into distinct and originally diverse families. As far as we have evidence, it is believed that there is a conformity in all fœtal skulls, and it is in after growth that by the arrest of certain parts and continued developement of others that the character of the cranium is fixed for and in each family. The Jew will continue to be a Jew, so long as Jewish education, habits, and customs, make and keep him so; and so with the African and every other.

The system of moral and religious government, which divine revelation attests to have been introduced into the world, was for the elevation of man, and to keep alive in him the obligations under which he labours to his Divine originator, affording a satisfactory answer to those who, in the history of the human race, see but the arbitrary decrees of an exacting judge; or who, plunging yet deeper into scepticism, from such assumed decrees, deny the controling and directing influence of an ever-present Creator and Governor of the universe. But to what do both revelation and history witness? The former declares man to have been created perfect: and even when information of a lapse from this high perfection is given, we do not find a stage of barbarism the immediate result; but, on the contrary, Cain and his descendants set about exercising the arts of civilisation, as they are termed, in high perfection; and of this unfortunate family a full account is recorded, illustrative of its continued downward course, until the earth is filled with violence. And after the fall of the first pair and the death of Abel, yet a remnant is loyal, and for its loyalty is elected to keep alive truth on the face of the earth, and to declare the knowledge of the only true God before the face of the world, and to raise up worshippers to fulfil man's destiny and God's intention that such a being should shew forth His praise and declare the wonders that He doeth. So, in the election of the house of Israel, and the establishment of the Jewish confederation: it was the reward of faith and obedience, and as a means of testifying to the corrupt and backsliding nations around, how a great Jehovah rewarded and punished his people.

Nor has this course of policy ever been departed from: for no sooner are the Jews, like Cain of old, waxed rebellious and fat in wickedness—no sooner do they corrupt themselves, as the nations around them, than the blessing is taken away—at least for a time—and their place supplied by a remnant of the good that came out of them, and a foreign, but convinced race, grafted in, to take up the chorus of praise and thanksgiving due to the long-suffering patience of Him who is infinite in mercy. It is always the same history: the many follow their own inclinations, the few submit to the will of Him who is their Lord. If we interrogate profane history, no other response is given than that which the sacred narrative has concisely declared before. We never have yet been told of, or discovered the abode of a people that have risen out of barbarism, to any degree of moral rectitude and true dignity, without having been influenced in their rise and progress by the example of some intruder or invader who held the truth. Nations have retained for a time their status in the political arena, and have witnessed to the full capacity of the human mind, and its extraordinary intellectual grandeur; they have shewn of what pure human intellect is capable, and they have shewn its inherent weakness. The wailing of an Infant cradled among the beasts of earth, startled this lofty pride from its throne, and laid the foundation of a people and a kingdom, which should worship in the beauty of holiness Him whose name is excellent in all the earth.

If we study the history of the lower orders of creation, we cannot fail to note the singularly striking effect which is produced by internal and external influences, on the conformation of creatures, both animal and vegetable, but always with fixed limits; and when, as in the animal, these changes of form are coupled with modifications either by admixture or otherwise, in the life-powers of the being, the varieties produced are the more striking. Sometimes the life-attributes outlasting, as it were, the physical form—as in the judicious crossing of the bull-dog and greyhound, or the latter and shepherd's dog—for we cannot refuse to admit that both sets of qualities, those of life and body, are handed down in organised beings.

That a similar law obtains among plants, we will illustrate also, by reference to the Himalayan Journal by Dr. Hooker, at page 20, vol. I. he says, "The ascent of the hills of Bahar was at first through woods of the common trees, with large clumps of bamboo, over slaty rocks of gneiss, much inclined and sloping away from the mountain. The view from a ridge, five hundred feet high, was superb. Descending to a valley, some ferns were met with, and a more luxuriant vegetation, especially of *urteceæ.* Wild bananas formed a novel and beautiful feature in the woods. The conical hills of the white ants were abundant. Ascending again, the path strikes up the hill, through a thick forest of Sal (*vateria robusta*) and other trees, spanned with cables of scandent banhinia stems. At about three thousand feet above the sea the vegetation becomes more luxuriant, and by a little stream I collected five species of ferns and some mosses. Still higher, climatis, thalectrum, and an increased number of grasses are seen, with bushes of verbenaceæ and compositæ. The white ant, apparently, does not enter this cooler region. A juniper—the European communis, deodar (possibly only a variety of the cedar of Lebanon and of Mount Atlas), pinus gerardiana, pinus excelsa, and cypresses tonelosa ; the names are given, because they shew how European the absent ones are, either specifically or in affinity. I have stated that the deodar *is possibly a variety of the cedar of Lebanon ;* this is now a prevalent opinion, which is strengthened by the fact that so many more Himalayan plants are now ascertained to be European, than had been supposed before they were compared with European specimens: such are the yew, juniperus communis, berberis vulgaris, quercus ballota, populus alba, and euphratica, &c. The cones of the deodar are identical with those of the cedar of Lebanon ; the deodar has generally longer and more pale-bluish leaves and weeping branches, but these characters seem to be unusually developed in our gardens ; for several gentlemen well acquainted with the deodar, when asked to point it out in the Kew gardens, have indicated the cedar of Lebanon, and, when shewn the deodar, declare that they never saw that plant in the Himalaya. I have seen, says Dr. Hooker, the magnificent pinitum of Dropmore—noble cedars—with the length and hue of leaf and the pensile branches of the deodar, and far more beautiful than that is, and *as unlike the common Lebanon cedar as possible.* When it is considered from how very few wild trees (and these said to be exactly alike) the many dissimilar varieties of the C. Libani have been derived, the probability of this —the cedar of Algiers, and of the Himalayas (deodar) *being all forms of one species, is greatly increased.* We cannot presume to judge from the few cedars which still remain, what the habit and appearance of the tree may have been when it covered the slopes of Lebanus; and seeing how very variable the coniferæ are in habit, we may assume that its surviving specimens give us no information on this head. Should all three prove one, it will materially enlarge our ideas of the distribution and variation of species. The botanist will insist that the typical form of cedar is that which retains its characters best over the greatest area, namely, the deodar; in which case the prejudice of the ignorant, and the pre-conceived ideas of the naturalist, must yield to the fact that the old familiar cedar of Lebanon is an unusual variety of the Himalayan deodar. The observations of Dr. Hooker are most felicitous, and we need scarcely direct attention specially to the last observations, as having a most important bearing on the question of the origin of varieties. That geographical position has a most important effect on the developement of animals, is also a fact supported by observation, too certain to admit of doubt. Thus, two of our commonest domestic animals, the horse and sheep, at page 243 of the journal of Dr. Hooker, so often quoted, we find the following: "We came suddenly upon a flock of gigantic wild sheep, feeding on scanty tufts of dried sedge and grass; there were twenty-five of these enormous animals, of whose dimensions the term sheep gives no idea; they are very long-legged, stand as high as a calf, and have immense horns, so large, that the fox is said to take up his abode in their hollows, when detached and bleaching on the barren mountains of Thibet. The ovis ammon of Pallas stands from four to five feet high, and measures seven feet from nose to tail; it is quite a Thibetan animal, and is seldom seen below fourteen thousand feet, except when driven lower by snow; and I have seen it as high as eighteen thousand feet. The same animal is, I believe, found in Siberia, and is allied to bighorn of North America." Again, in Darwin's voyage, he describes the cattle of the Falkland Islands as fine: he says, I never saw such magnificent beasts; they equalled, in the size of their huge heads and necks, the Grecian marble sculptures. Captain Sulivan informs me that the hide of an average sized bull weighs forty-seven pounds, whereas a hide of this weight, less thoroughly dried, is considered a very heavy one at Monte Video. During our whole ride we saw only one troop of wild horses; these animals, as well as the cattle, were introduced by the French in 1764, since which time both have greatly increased. It is a curious fact that the horses have never left the eastern end of the island, *although there is no natural boundary to prevent them from roaming*, and that part of the island is not more tempting than the rest. Considering that the island does not appear fully stocked, I was curious to know what had checked their progress. Captain Sulivan has taken much pains in the enquiry. The Guachos employed here attribute it chiefly to the stallions constantly roaming from place to place, and compelling the mares to accompany them, whether or not the young foals are able to follow. A Guacho told Captain Sulivan that he had watched a stallion for a whole hour, violently kicking and biting a mare, till he forced her to leave her foal to its fate. Captain Sulivan can so far corroborate this curious account, that he has several times found young foals dead, whereas he has never found a young calf. Moreover the dead bodies of full grown horses are more frequently found, as if more subject to disease than cattle. From the softness of the ground, their hoofs often grow irregularly to a great length, and this causes lameness. All the horses, both tame and wild, are rather small sized, though generally in good condition ; and they have lost so much strength, that they are unfit to be used in taking wild cattle with the lasso. At some future period, the southern hemisphere probably will have its breed of Falkland ponies, as the northern has its Shetland breed. The cattle, instead of having degenerated, seem to have increased in size, and are much more numerous than the horses. They vary much less in the general form of their bodies, and in the shape of their horns, than English cattle. In colour they differ very much ; and it is a remarkable circumstance, that in different parts of this one island different colours predominate. Round Mount Usborne, at a height of from one thousand to one thousand five hundred feet above the sea, about half of some of the herds are mouse or lead colour, a tint which is not common in other parts of the island. Near Port Pleasant, dark brown prevails ; whereas, south of Choiseul Sound, they appeared like white spots on the hill-sides ; these beasts have black heads and feet. Captain Sulivan remarks that the herds do not mingle ; and it is a singular fact that the mouse-coloured cattle, though living on the high land, calve about a month earlier in the season than the other coloured cattle in the lower land. [Lord Jersey has shewn that, in England, cows in calf to a particular bull, have longer or shorter periods of gestation.] It is interesting to find the once domesticated cattle breaking into three colours, of which some one colour would, in all probability, ultimately prevail, if the herds were left undisturbed for several centuries. The rabbit is another animal which has been introduced; yet, like the horses, they are confined within narrow limits, for they have not crossed the central chain of hills. The French naturalists have considered the black variety a distinct species, and have called it lepus magellanicus; they imagined that Magellan, when talking of an animal under the name of "conejos," in the Straits of Magellan, referred to this species; but he was alluding to a small cavy. The Guachos laughed at the idea of the black kind being different from the grey, for that the two were never found separate, and that they bred together and produced piebald young. Of the latter, says Darwin, I now possess a specimen, and it is marked about the head different from the French specific description. The distinction of the rabbit as a species is taken from peculiarities in the fur, from the shape of the head, and from the shortness of the ears. I may observe that the difference between the Irish and English hares rests upon nearly similar characters, only more strongly marked. With reference to my own specimen, the circumstance shews how cautious naturalists should be in making species; for even Cuvier, on looking at the skull of one of the rabbits, thought it was probably distinct. Is man under a different system of laws, or is he subject to these external circumstances or not?

The first inhabitants of the earth must have been men of like passions with those now living, and have been moved by the same circumstances which influence the actions of men at this day. What then, we will ask, is one of the strongest features in the human character? The tendency to family isolation; the tendency in the family to tribal organisation, and in the tribe to enlarge itself into a mightier and therefore national confederacy, and the nation to maintain a dominant position by such influence, as a consequence of the more or less restricted intercourse which must ever ensue from such a combination; we thus derive family likeness in its widest sense, and at length national peculiarities, which are but multiplied family resemblances. So strong is the disposition in the human race to perpetuate its *family* peculiarities, that we cannot find a single instance of any people dwelling for any length of time in close proximity to each other, without one or the other obtaining an ascendancy, either by superior mental and physical force, or strategy, or else by the equally certain process of absorption or amalgamation; and in those cases where we find the primitive stock still maintaining its distinctive characters, there has been continued isolation, produced either by religious antipathy, or by other equally potent causes of separation. What preserves to the Jew his form and special attributes, but the unchanged type of mind, his prejudices, his customs, which determine his destiny; his whole nationality lives in him yet; how can he change?

The negro, whose whole history tells how persecution and years of degradation may sink humanity, tells, too, how that degradation may be wiped out, and his form become once more elevated. We know not how serious and enlightened men dare to put forward the negro variety, as an instance strongly in favour of their doctrine of diverse origin. Will they tell us what chance these persecuted people have had of raising themselves in the scale of civilisation? See them on Egyptian tablets bound in fetters; behold them at this very hour manacled, and sold in the markets of relentless oppressors. But is it true that the conformation of the negro remains the same at this time, as when he crouched in Egyptian bondage? We unhesitatingly answer that he does not. The West Indian negro—the descendant of the African negro stock—is not the same negro in form as his ancestors, if he has undergone education and civilisation; and although the natural law which governs transmitted or transmissible features cannot be set aside, yet we find that external circumstances have a strong tendency to modify the character both of body and mind, and to stamp certain peculiarities on the family. In a district in Ireland, according to Humboldt, poverty and isolation have conspired to degrade a portion of the people, and reduce them in form towards that of the negro. In Barbadoes, similar causes have dwarfed some poor white people to such a degree, that I have seen some of both sexes, who were known to be twenty-four years old, who, in body and mind, were no more advanced than boys or girls of nine or ten years of age. It is now well known that in Africa it is only in a particular area that the true negro is found, and that from the negro to the several surrounding families, the transition is gradual until we come to the Kaffir and Bashukulumpo, and the Londo race, closely resembling the ancient Egyptians; thus according with the remark made by Pritchard, who found that many Egyptian heads bore a striking resemblance, both to Ethiopic and Negritian type; and Dr. Livingstone remarks of the Kaffirs, that their splendid physical developement and form of skull shew that, but for the black skin and woolly hair, they would take rank among the foremost Europeans. The travels of Barth and

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Livingstone have done more to enlighten us as to the true condition of Africa than any writers who have preceded them ; and so far from the people of that wide spread area being even national in their forms or inner life, they are known to be as diverse as possible. The deviations in external character among the aboriginal inhabitants of North America, although sufficiently characteristic, are nevertheless much less easily described or discovered : similarity of climate and pursuits and mental occupation, rendering a wide separation impossible ; but even among the North American Indians, there is not that close uniformity which ought to exist if the type of cranium was a fixed fact, and this Morton's own tables of measurements and illustrations most clearly prove.

The authority who receives great deference and enjoys the implicit confidence of his school is the learned American, Dr. Morton, from the pages of whose work satisfactory refutation of the doctrine of uniformity may be drawn ; and it will appear that the alleged hybridity of the mixed races is destitute of truth ; and that, on the contrary, the improvement in nations and families has been generally brought about by the intrusion of new blood. We have already observed that the Egyptian records furnish the oldest information of the human family ; and surely that information does not contradict the experience of younger annals. We there discover types of crania peculiar to those ancient people ;

and looking to Egypt now, we ask, where is the Egyptian? Both Dr. Morton and Messrs. Nott and Gliddon present us to a race which they declare to be a mixed race, nor can we discover any valid reason for supposing that this compound people were preceded by an aboriginal race. "We read," says Messrs. Nott and Gliddon, "the '*Crania Egyptiaca*' of Morton with intense interest, as soon as it was published; and down to the time when Lepsius' plates of IVth., Vth., and VIth. dynasties appeared, we had not ceased to regard his *Egyptian type* as the true representative of the old empire; but the first hour's glance over those magnificent delineations of the primeval inhabitants, produced an entire revolution in our opinions, and enforced the conviction that the Egyptians of the earliest times did not correspond with Morton's description, but with a type which, although not *negro*, nor akin to any negroes, was strictly *African*,—a type, in fact, that supplied the long-sought for link *between* African and Asiatic races." The negroid type of the earlier dynasties seems never to have become extinguished, notwithstanding the immense influx of Asiatics into Egypt, and which has been going on literally for thousands of years to the present hour. It may be received in science as a settled fact, that where two races are thrown together and blended, the type of the major number must prevail over that of the lesser, and in time the latter will become effaced. This law, too, acts with greater force where a foreign is attempted to be engrafted upon a native type suited to local climates. The Fellahs of Upper and Middle Egypt, at the pesent day, continue to be an unmistakeable race, and are regarded as the best living representatives of the ancient population of Egypt. Now we imagine that the same reasoning which is here applied to the Egyptian family, will apply to all or most of those lying around the African and negroid influences. Thus the Libyan family, as described by Morton, are found to the north and south of Mount Atlas, extending their wanderings into Morocco and Barbary. On the east coast they inhabit as far as the Gulf of Cabes, or the Little Lyortis, while on the west they reach the Atlantic. The *various* communities of this family are characterised by handsome Caucasian features, but in complexion they present all the shades *from white to nearly black;* and it is worth while to trace the varieties of this family, in order to discover why Dr. Morton should refuse to assign to each of the divisions of the family a separate "centre of creation," for certainly a greater catalogue of disagreements it would be difficult to enumerate: thus—

The *Tuaricks* are the best known of all the Berber tribes. Captain Lyon describes them as the handsomest men he ever saw: tall, straight, and handsome, with an imposing air of pride and independence. Their features resemble those of southern Europeans; their natural complexion is nearly white, *much darkened*, however, by *exposure* to the hot sun; and the hair is long, black, and glossy. They are said to be less treacherous than the Arabs, yet passionate and revengeful. They are fond of war, and plunder both their Arab and negro neighbours, and reduce the latter to slavery.

The *Skillochs*, who inhabit south of the Tuaricks, are less robust, and have darker complexions; they are industrious, peaceful, civilised, and humane, having some manufactures: being more husbandmen than shepherds.

The *Adem*, who inhabit the oasis of Ghadmis, south of Tripoli, are divided into two tribes, which are at constant war with each other. To this family, also, belong the Beni-Mozab, and other tribes of Belad-el-gerid, south of Atlas; the Zouaves of the Tunisian territory; the Kollurians, in the neighbourhood of Loudan; the Tagama, near Timbuctoo, who are *white;* and the Hagara and Matkara, who are yellowish.

The *Kahyles*, who appear to be intimately connected with the Berbers, inhabit the higher part of the Algerine and Tunisian territories, living in mountain villages composed of huts, which resemble the *Magalia* of the old Numidians. They are generally of a swarthy colour, with dark hair; but those who inhabit the mountains of Auress, though they speak the same idiom, *are of a fair and ruddy complexion*, and their hair is of a *deep yellow.*

I am at a loss, continues Morton, where to place the Galla of eastern Africa; yet they bear a general physical resemblance to some of the Berbers. They are of small stature, with long black hair, and complexions varying from brown to black. They are among the most warlike and remorseless barbarians of Africa; and their principal tribe, the Boren-Salla, now govern by conquest in Abyssinia, and even occupy Goudar, the capital. They are supposed to spring from that unknown region which constitutes the southern interior of the continent. We have here as diverse a people as could well be found, and yet Dr. Morton is satisfied to include them in one family. In Asia the families differ gradationally, and in Africa the same history is brought to light.

Pritchard gives a good portrait of the race in which the negro feature is approached very decidedly. In the immediate vicinity of Mount Atlas the distinctions of race are often altogether confounded, owing to the proximity of the negro tribes. Thus, the Tibboos are nearly black, and have very long wiry hair—*intermediate* between that of the Tuarick and negro; yet their features are good, and their forms delicately and even beautifully moulded. The immemorial predatory habits of these various tribes, amply account for the blending of physical characters ; for the Tibboos mix with the negroes, the Tuaricks enslave the Tibboos, and the Moors in their turn make enemies and slaves of them all. Again, the Moslem-Egyptians are composed of two classes, the Copts and Fellahs. The Copts, though *now remarkably distinct* from the people who surround them, derive from their remote ancestors some mixture of Greek, Arabian, and, perhaps, even negro blood. They present various shades of complexion, from a pale yellow to a deep bronze or brown. Another fact, from Dr. Morton, will satisfy us that colour cannot be taken into our consideration, in determining the family. The New Zealanders (as with many others) in complexion vary between white, brown, and black. The better classes have the olive and yellowish-brown tint of the Malays, with hair long and black, and generally more or less frizzled. In turning to the most recent writer, Dr. Livingstone, we are struck with astonishment at the various forms which every where met him in his travels through Africa ; and the hostile and degrading warfare which is continually waged by the wretched inhabitants against each other, has evidently had the effect of isolating tribes far more effectually than ever has been the case with the North American Indians, where the general family resemblance is more apparent. The same writer has not failed to observe the marked impress of the Egyptian type in some races with whom he came in contact; and throughout his work, as well as that of Morton, we constantly discover a blending of races; for if, on the one hand, we do find what is styled a perfect Egyptian or perfect negro, we as constantly detect gradational varieties between the two, and sometimes between several others. Thus, the Bashinge seem to possess more of the low negro character and physiognomy than either the Balonda or Basongo; their colour is generally dirty black; foreheads low and compressed; noses flat and much expanded laterally, though this is partly owing to the alæ spreading over the cheeks by the custom of inserting bits of sticks or reeds in the septum; their teeth are deformed by being filed to points; their lips are large. They make a nearer approach to the general negro appearance than any tribes I met; but I did not notice this on my way down. The people residing on the Loojina seemed more slender in form, and their colour a lighter olive

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than any we had hitherto met. The mode of dressing the hair, which lay upon their shoulders, together with their general features, again reminded me of the Egyptians. The features given are frequently met with; but they are by no means universal. The inhabitants of the island of Menye, as seen by Livingstone, were muscular, and had large ploughman hands. Their colour was the same admixture, from very dark to light olive, that we saw in Londa. Though all have thick lips and flat noses, only the more degraded of the population possess the ugly negro physiognomy. The experience of the great African traveller clearly proves that the inhabitants of Africa are exceedingly diverse in their external appearance; and that isolation produces as certain degradation amongst them as amongst other people, and a free admixture of the tribal families as certain improvement in physical aspect and mental vigour. But the most general principle established by the observations of Dr. Morton, Mr. Gliddon, and Dr. Livingstone, is, that in no single instance can there be discerned the actual origin of one of the many families now inhabiting the earth. The Egyptian of Dr. Morton's first finding, he afterwards assumed to have been preceded by an aboriginal people; but on what true principle we know not, since all analogy would lead to the inference, that they, too, may have been an intrusive family.

It is also to be remembered, that the varieties of man which are found in Africa alone, are so extreme, that if we are to accept the theory of a diverse origin, we must have as many centres in Africa as there are diversified groups; and the same would apply to the Indo-European families. If, however, we investigate the character, position, and general history of any one or all of the inhabitants of the areas so peopled, may we not detect the causes of the many differences which are admitted to exist? We have already pointed out the dual communication which exists with the inner man; it has been shewn how the *animal* life may be allowed to triumph, the senses leading captive and obtaining dominion over the whole being, until man becomes a mere creature of instinct; or how reason and a disciplined mind, maintaining the mastery, may elevate and ennoble the soul to its highest destiny. It is therefore folly to attribute to any *one* cause the varied results of man's developement, for while innate forces are contending within him, he is re-acted on by very many external causes, all of which have more or less influence upon his mental and bodily forms. M. Cousin, in his usual brilliant language, strongly sets this truth forth: "Which one of you believes that the land which he inhabits, the air which he breathes, the mountains or rivers which are his neighbours, the climate and all the impressions which result from it; in a word, that the external world is indifferent to him, and exercises no influence upon him? It would be on your part an idealism somewhat extraordinary; I imagine that you think with all the world that the soul is distinct from, but not absolutely independent of the body. Do you think, and does any one ever think, that the man of the mountain has, and could have, the same habits, the same character, and the same ideas as the man of the plain, of the river-side, of the island? Do you suppose that the man whom the fires of the torrid zone consume, might be called to the same destiny in this world as he who inhabits the desert icy regions of Siberia? That which is true of these two extremes of the frigid and torrid zones, ought to he equally true of two intermediate places, and of all latitudes." The old world, says Guyot, and the new world differ in the groupings, and in the number and extent of the continents composing them; in their astronomical situation, with respect to the climatic zones; in the general direction of their lands; in their interior structure. This assemblage of opposite characters secures to each of them a climate, a vegetation, and an animal kingdom peculiarly its own. The old world is composed of four continents. Setting aside Australia, which is only an island in the midst of the oceanic hemisphere, it numbers three, all very near each other, aggregated and forming an oval compact mass, whose extent far surpasses that of every other terrestrial space. It presents a solid extent of land, the most vast, the most unbroken, the least accessible *in its centre* to the influence of the ocean. The old world is pre-eminently the *continental* world.

The new world has only two continents, North and South America—America and Columbia. They are not grouped in one mass, nor placed side by side, but separated from each other; not touching upon their long sides, but by their exterior angles; standing in line rather than grouped. They are situated in two opposite hemispheres. M. Guyot goes on to say, "What characterises the interior structure of the new world is its simplicity. In place of the variety of the old world, when in spite of a few general features common to both, each continent is, as it were, cast in a separate mould, the two Americas seem absolutely formed upon the same plan. America is less rich in internal contrasts than the old world, but has more of unity, because it is more simple. Undoubtedly in this uniformity of structure, in this absence of obstacles to *a free circulation* from end to end of this world, we are to look for one of the principal causes of that common character of that American physiognomy, which strikes us in all the organised beings of this continent; and which we find again in man himself—in the Indian—all the tribes of whom, from the banks of the Mackenzie river to Patagonia, have the same coppery tint, and a family likeness in the features impossible to mistake." This opinion of M. Guyot receives confirmation from, and may also serve to elucidate a declaration made by Dr. Knox, as to the unsuitableness of the climate of the Americas to the European people. There are many strong reasons for receiving—but partially—the statement made by the learned anatomist, since many other close observers are likewise impressed with the conviction that there is a tendency to degeneracy in the European settled in America. Dr. Knox remarks of the tropical regions of the new world, that every one knows that none but those whom nature placed there can live there; that no Europeans can colonise a tropical country. May there not be some doubts of their self-support in milder regions? Take the Northern States themselves; there the Saxon and the Celt seem to thrive beyond all that is recorded in history. Are we quite sure that this is fated to be permanent? Annually, from Europe, is poured in a hundred thousand men and women of the best blood of the Scandinavian, and twice that number of the Celt; and so long as this continues, they are sure to thrive. But check it, as in the case of Mexico and Peru: throw the *onus* of reproduction upon the population—no longer European, but a struggle between the European alien and his adopted father-land. The climate, the forest, the remains of the aborigines not yet extinct; last, but not least, that unknown (?) and mysterious degradation of life and energy, which in ancient times seems to have decided the fate of all the Phœnician, Grecian, and Coptic colonies, will produce analogous effects. Cut off from their original stock, they gradually withered and faded, and finally died away. Already the United States man *differs in appearance from the European:* the ladies early loose their teeth; in both sexes the adipose cellular cushion interposed between the skin and the aponeuroses and muscles, disappears; the muscles become stringy, and show themselves; the tendons appear on the surface; symptoms of premature decay manifest themselves. Now we do not dispute the facts stated by Dr. King: it is notoriously true that the condition which he describes as pertaining to the larger class of the American people is correct; but, as Dr. Latham very properly observes, to work out questions in such cases, there must be some reference to the general operations of climate, food, and other influences: operations which imply a *correlative* susceptibility of modification *on the part of the human organism.* If we find a people whose habits of life and dietary system are so wretchedly inconsistent with the most ordinary laws of health, is it to be wondered at if signs of degeneration are manifested amongst them? Are not the hundred and one varieties of dyspepsia to be seen in every city and town of the Union, to be attributed to the mode of life of the American; and, as a consequence, the dentist is in constant requisition, to supply by art that which three-fourths of the people lose, not from any vice of the climate, but from the want of vigour, produced by the demi-starvation which must result from impaired digestive powers. Dr. Knox clearly alludes to *Lower* Canada, not to Upper Canada, when he speaks of the European-French stock having degenerated. In the former, the French race have been for a long time isolated: a sparse population breeding in and in, and mixing but little with the old blood of France, or that of other European people. They have been a virtuous, contented, happy race; and, both from religious and national sentiments, confining themselves to the portion of country in which their lot was cast. If, therefore, we do find small men and small horses, we find all the old primitive habits of the parent stock unchanged, shewing how completely they have refrained from intermixture. But what of Upper Canada? We answer, that the children of Britain, the sons and daughters of Scotland, England, and Ireland, are not only not a degenerate, but an *improved* race. The agricultural districts of Upper Canada can produce as many tall, athletic, well formed specimens of humanity as are to be found at home; and if Canada may boast of any one thing more than another, it is of the athletic forms of her people.

The wealth, inexhaustible and easily gathered, which the hand of Benificence has strewed on the wide surface of the land; the magnitude and magnificence of inland seas, waving rolling plains, and accessible but far stretching mountain ranges, stir the mind to efforts of gigantic grasp, and feed it with ideas which sometimes seem too mighty to be achieved. The red man, the child of the forest, pales before the intruding race: shut up for ages in the dark recesses of his home, cut off from intercourse with his fellow men, degraded in mind and body, the external face of nature stamps upon him a peculiar character, while the hidden treasures of national prosperity and advancement lay at his feet, unknown and uncared for. In Asia, Africa, and Europe, how striking the contrast? Egypt, for instance, but a few hundred miles in length, gave birth to a people whose history is the wonder of the earth. Africa has its diverse families, and Europe continues to preserve its nationalities, however much they may fluctuate. Man, thus the sport, as it were, of circumstances, the creature on whom such mighty influences are constantly operating, cannot fail but to be impressed by them. The brain, the organ of the mind, furnishing to that mind intelligence through the sensory organism, or through its more noble hemispheres,—the immediate organ of the Me—must, in proportion to the dominancy of either, stamp a configuration on the skeletal envelope. The form and fashion of the cranium cannot but be determined by the form and fashion of the mind. The Indian mind could only be reflected from a form of brain which was low in moral power, high in its animal and instinctive or automatic capabilities. The unlettered Australian sighs not for knowledge, his heart quickens not its pulse at the touch of one generous emotion, or at the sight of human woe. The African, dead to all high and lofty sense of morality, dwelling amidst scenes of brute violence, familiarised from infancy to manhood with the roaring of beasts of prey, and on the defence against them, becomes imbued with their savage nature, and has his own fashioned on a plan scarcely removed from theirs. The European and the Asiatic, under the influence of the true and a false religion, and surrounded by better external circumstances, have developed the faculties of the mind in their due proportion; and the former, superior in the exercise of a lofty reason, and governed by the higher faculties of the soul, wins the inheritance of the more brutalised man. The birth of every nation under heaven is lost in the night of the past. Egypt sprang (so far as we can discover) into existence a race of intellectual giants, and claims to be born of gods and demi-gods. Mr. Grote says of Greece: "The mythical world of the Greeks opens with the gods, anterior as well as superior to man: it gradually descends, first to heroes, and next to the human race;" and the dawn of Rome is still hidden in mist. It is quite true that we do find the primitive races still living members of the family of men; but are they not yet under the very same influences which surrounded them in ancient times: has the African, even when brought from his native home, ever been permitted to enter into the possession and free enjoyment of the privileges and powers which are exercised by his more fortunate white brethren; does the degrading lash of the task-master no longer crush that spirit of humanity, which now, more than ever, cries out for christian aid, teaching his oppressors that the slave may thirst for freedom? The Jew, as we have already said, remains even now a Jew; and wherefore not? have they yet learned to mingle their blood in Gentile veins? do they learn to be citizens of any kingdom, or have they ever attempted a settled home? And the Greek, what of him? We may find in the population most remote from European blood, the old cranial type; but does not the exception in this very case prove that the original type, permanent only by isolation, has in the other case been changed, no doubt by infused blood, as well as lost national status, and given to us a mixed and diverse race. The Carib of the little island of St. Vincent is the Carib still; but what marvel! he lives in the pent-up corner of his island home, the proud inheritor of old cherished customs. The Ethiopian cannot change his skin, nor the leopard his spots; so long as Ethiopic influences surround him, for so long as his moral degradation continues, will he perpetuate his special organisation. Elevate him by stimulating and expanding his higher faculties, as christianity will yet do for the African, and his perfect equality with the white man will be apparent. Mr. Gliddon says: "Mr. Lyell, in common with tourists less eminent, but, on this question, not less misinformed, has somewhere stated that the negroes in America are undergoing a manifest improvement in their physical type. He has no doubt that they will, in time, shew a developement in skill and intellect quite equal to the whites. This unscientific assertion is disproved by the cranial admeasurements of Dr. Morton." How? in what way? Does our author mean for a moment to intimate, that the American-African has had even the slightest chance to develope intellectual power; have they enjoyed any of those minor privileges which free men in their most degraded condition possess? Where are the high schools or low schools in which to train the black-skinned youth? Why, even in the house of God the Amen of a negro would invoke the anathema of the praying white christian. What say the records of a christian church? That, to this hour, the Church in the United States excludes from her synodal assemblies the black man; even coloured congregations gather themselves together as distinct and isolated communities. Short as has been the time since emancipation, we must cast our eyes to the West Indian Islands for occular and substantial proof of the change which may be effected in the negro type, even in a brief space of time ; and so far from obtaining evidence of the stationary nature of the African; on the contrary, it is seen that the moral, political, and other conditions of the race are rapidly advancing. Even in America, under the most disadvantageous circumstances, this is admitted ; and Mr. Nott is forced to acknowledge, "that the negroes imported into or born in the United States, become more intelligent and better developed in their physique generally, than their native compatriots of Africa, every one will admit ; but such intelligence is easily explained by their ceaseless contact with the whites, from whom they derive much instruction. [Is it in the same way as that by which the white American race has increased its intelligence, by ceaseless contact with all the European races ?] Their physical improvement may also be readily accounted for, by the increased comforts with which they are supplied. One or two generations of domestic culture, effect all the improvement of which the negro organism is susceptible." This disingenuous conclusion is untrue, and is illustrative of that narrow prejudice characteristic of some men ; first educate the negro, and if he is idiotic, then condemn him : but the intelligent man will look on this declaration of Mr. Nott's as a cruel mockery, and cold, heartless insult to a poor oppressed people. "Domestic culture," under the scourge and torment of a hard master, effects all the improvement of which the black is susceptible! On what principle a bar is placed against improvement we know not; prejudice alone seems to dictate the declaration, and already the emancipated West Indian slave gives a flat contradiction to it. We need not, however, confine ourselves to the instance of the black; history attests that no nation has risen to importance through isolation, and but for the intermixture of peoples, degradation must have been the common lot, if men had continued to occupy small centres. With the loss of her national supremacy, Spain has been crumbling to decay; and Mexico, in the agony of death, awaits regeneration, by being amalgamated with the Anglo-Saxon blood.

Prof. Daniel Wilson, whose standard work is acknowledged with respect by every lover of science, in speaking of Britain, asks, "Was the bronze period superinduced on the primeval one by internal improvement and progression, or was it the result of the intruded acts of a superior race? This, it is manifest, can only be determined by an extensive series of observations, since physiologists are *generally agreed in admitting that the physical characteristics of races have been largely modified, and even entirely altered by a change of circumstances.* The nomadic Turkish tribes, for example, spread through central Asia, still exhibit the broad-faced, pyramidal skulls which Dr. Pritchard has assigned to the nomadic races; while the long-civilised European Turks have become closely assimilated to other European races, and possess the characteristic oval skull. The greater relative developement of the jaws and zygomata, and of the bones of the face altogether, in comparison with the size of the brain, *indicates* in the pyramidal and prognathous skulls, a more ample extension of the organs subservient to *sensation* and the *animal* faculties. Such a configuration is adapted, by its results, to the condition of human tribes in the nomadic state, and in that of savage hunters. Two important points, therefore, which remain to be determined in relation to the British tumuli, are, whether the forms and proportions of the skulls of their builders indicate the existence of one or several races? and, next, whether the changes in the forms of the crania are sudden and decided, or are gradual, and pass, by an undefined transition, from the one to the other? Archæological evidence points to a transitional state from the stone to the bronze period, such as is altogether irreconcilable with the idea of the sudden extermination of the aboriginal race. It at the same time no less distinctly points to the existence of a native population in Britain, long anterior to the earliest historic indications of the Arian nations passing into Europe."

To these early races, which we describe loosely as primitive, Dr. Pritchard has suggested the application of the conveniently indefinite term, 'Allophyllian,' which suffices to distinguish them from the well ascertained primitive races, without meanwhile assuming any hypothetical origin for them. Of the Allophyllian colonists of Scandinavia, Prof. Wilson assigns to the most ancient the short or brachy-kephalic form of cranium, with prominent parietal tubers and broad and flattened occiput. To this aboriginal race, he conceives, succeeds another, with a cranium of a more lengthened form, and prominent and narrow occiput. The third race which Scandinavian antiquaries incline to regard as that of the bronze, or first metallic period, is characterised by a cranium longer than the first and broader than the second, and marked by greater prominency at the sides. The last, Prof. Wilson considers to have been of Celtic origin. To this succeeded the true Scandinavian race, and the first workers of the native iron ore. Prof. Eschricht assigns to the crania from the barrows of the oldest Danish series an ample and well developed form, with the forehead vaulted and tolerably spacious, and the nasal bones prominent. In a skull described by him, the zygomata appear large and angular, and the cranium has somewhat of a *pyramidal* form. The eyes have been deeply set, and the eye-brows are strongly prominent. One of the most unmistakeable features in these skulls is their round form, approaching to a sphinical shape. The type of the old Celtic cranium is considered by Prof. Wilson as intermediate to the lengthened and shortened oval, or the true dolicho-kephalic and brachy-kephalic forms; and in this conclusion Dr. Thurnam coincides. Dr. Morton describes the Celtic head as rather elongated, and the forehead narrow and but slightly arched, the brow low and bushy, the eyes and hair light, the nose and mouth large, and the cheek bones high. Such characteristics differ decidedly from those of the early barrows. A similar change in the Egyptian cranium is described by Dr. Morton. We trace the peculiar style of countenance in its several modifications, through epochs and in localities the most remote from each other, and in every class of the Egyptian people. How different from the Pelasgic type, yet how evidently Caucasian! How varied in outline, yet how readily identified! And if we compare these features with those of the Egyptian series of embalmed bodies, are we not forcibly impressed with a striking analogy, not only in osteological conformation, but also in the very expression of the face? This type is certainly national, and presents to our view the genuine Egyptian physiognomy, which, in the ethnographic scale, is intermediate between the Pelasgic and Semitic forms. A closer examination evidently induced Dr. Morton to regard these his "genuine Egyptians" as the successors of a yet more ancient race; for, subsequent to the publication of the crania, he again writes, "I am more than ever confirmed in my old sentiment, that northern Africa was peopled by an indigenous and aboriginal people, who were dispossessed by Asiatic tribes." We have here evidence of change in the crania of races, arising from the introduction of new blood by intrusion of new families. We apprehend more fortunate illustrations could not have been selected than those of the Egyptian and Jew, for what is the history of both these people? In the former case, we have a people occupying a tract of conntry of most limited extent, and, small as it was, split up into contending factions, which yet more effectually circumscribed its people. An appeal to the restored history of this singular people, would seem to point to the inference, that whoever they originally were, or wherever derived, they came into Egypt an intellectual people. The perfection of Egyptian art, says Osburn, is to be found in the monuments which are of the *remotest* date. The most ancient remains with which we are acquainted, are those in which the largest amount of artistic and handicraft skill has been displayed. It is a remarkable circumstance, says Lepsius, that the antiquity of Egyptian monuments, considered in relation to the larger masses of their remains, become *less* remote the higher we ascend the valley, in direct opposition to that which might have been anticipated according to the very generally received theory, which assumes that Egyptian civilization in the valley of the Nile originated in the south, and extended itself northward. While the pyramids of lower Egypt, with the tombs that surround them, brought to our view the wonderfully ample details of the most ancient civilisation of the third, fourth, and fifth dynasties, we found the sixth and the full bloom of the twelfth, the last of the old kingdom, principally represented in middle Egypt. Thebes was the glorious metropolis of the first dynasties of the new kingdom, surpassing all that had gone before, and all that followed, in the number, magnitude, and the beauty of her monuments, and presenting, even yet, a reflection, however faint, of Egypt in the palmy days of her highest prosperity. Egyptian art, accomplishing great works even in its decline, has left behind it a range of stately temples, all executed by Ptolemies and Roman emperors, and all, with the single exception of Dendra, occurring in the southern portion of the Thebaid, or in lower Nubia. The Egyptian monuments which are situated the farthest of all to the south, in the valley of the Nile, viz., those on the island of Meroe, are likewise the most recent of all, and were, for the most part, begun after the commencement of the Christian era. It will, adds Osburn, be easy to fill up the slight but able sketch borrowed from this accomplished scholar. The most ancient city of Heliopolis stands near the crown of the Delta, on the eastern bank of the Nile. In the palmy days of Greece it was the great resort of those of that enquiring and restless people, who, like Plato, were curious to search into the wisdom of the Egyptians. Immediately opposite the site of Heliopolis, on the western bank of the Nile, are the great pyramids of Egypt. The rocky platform on which they stand is the northern extremity of the range of low limestone hills, which extend southward thence for more than seventy miles to Howara in the Faium. Throughout this entire distance, the rock is crowned with pyramids, and perforated with tombs. It has visibly served as the burial place of a populous nation for many ages. It is in the innumerable tombs of this platform that we find the most ancient remains that have been preserved in any part of Egypt. In wonderful acceptance with the indication of Lepsius, the cemeteries of Gizeh and Abousir, which are the two northernmost groups of tombs in the entire range, belong to epochs more remote than those of the cemeteries to the southward. It is here, therefore, that the most ancient monuments of Egypt have been preserved. Those to the southward are of more recent date. If we proceed from Gizeh northward, no single monument has yet been found in any locality there of an earlier date than the eighteenth dynasty, with which, according to the arrangement we follow, the new kingdom of Egypt commences. Thus, then, we are able to indicate with certainty the point in the valley of the Nile in which are found the monuments of the remotest antiquity; and therefore, by the unerring analogy of the customs of all nations, the spot in which the first settlement in Egypt took place. Every thing, both to the northward and southward of this point, is more modern. This point lies exactly parallel to the Isthmus of Suez, and is precisely the place at which immigrants over that thoroughfare, between Asia and Africa, would first find a locality suited to their purpose after traversing the sands of the desert, and attempting in vain to penetrate the swamps of the Delta. After discussing fully the archæological and ethnological proofs, which the remains and language of the people afford, Mr. Osburn says, "The reasonable inference from these facts appears to be, that the first settlers in Egypt were a company of persons in a high state of civilisation; but that through some strange anomaly in the history of man, they had been deprived of a great part of the language, and the entire written system, which had formerly been the means and vehicle of their civilisation." We contend that this is the only reasonable or possible inference, even if no account of the first dispersion of man had ever reached us.

Combining this inference with the clear unanswerable indications we have pointed out—that the fathers of ancient Egypt first journeyed thither across the

Isthmus of Suez, and that they brought with then the worship of the setting sun ; how is it possible t resist the conclusion that they came thither from th plains of Babel, and that the civilisation of Egyp was derived from the banks of the Euphrates ? I is more than probable, therefore, that this peopl who so settled in Egypt were of a peculiar type, a Dr. Morton supposes, and preceded that mixed character which was afterwards so general in the nation Champollion, Rosellini, Heiren and Ruppell detect the Nubian physiognomy every where on the monuments ; and Dr. Morton, at one time, adopted the opinion that the Egyptians and monumental Ethiopians were of the same lineage, and probably descended from a Libyan tribe. Mr. Gliddon's commentary on Morton's opinion, is not a little amusing on account of its inconsistency. "To our view," he says, "Morton struck the true key to the type of the Egyptian population of the NEW empire. They were *then* already a *mixed* people, derived from Asiatic superpositions upon the aboriginal people of the lower Nile. From the dawn of monumental history, which antedates all chronicles, sacred or profane, we see the whole basin of the Nile, together with that part of Africa lying north of the Sahara, inhabited by races unlike Asiatics, and equally unlike negroes ; *but forming in anthropology a connecting link, and geographically another gradation.* To say nothing of Egyptians proper, such were and are the Nubians, the Abyssinians, the Gallas, the Barobra, no less than the whole native population of the Barbary States." We imagine that to an honest and well constituted mind, this "connecting link" and "geographical gradation" would be a serious stumbling-block in the way to a reception of such doctrine as Mr. Gliddon delivers; and ere we could receive such a theory, we would demand of its advocates the aim and end of the creation of human races at different centres, *if* in the course of a few generations amalgamation with improvement was to be the inevitable sequence. Already in the American Union the native-born descendants of the European family is assuming a special developement, which is as marked and *national* as the most burning patriot could desire; whether the form is deteriorating, as Dr. Knox supposes, is beside the question; but there can be no doubt that notwithstanding the constant infusion of new blood, a new and marked American type is becoming rapidly established. The numerous investigators, who have amply detailed their impressions and observations concerning the different families, all agree in the existence of connecting links; and no where do we find a race absolutely distinct from its neighbours: tribal and family peculiarities there are, and no where more strongly marked than in the savage and degraded races of Africa. Dr. Latham truly observes, "If the word *negro* mean the combination of woolly hair, with a jetty skin, depressed nose, thick lips, and prominent jaw, it applies to Africans as *widely different* from each other as the Laplander is from the Samoeid and Esquimaux, or the Englishman from the Finlander. It applies to the inhabitants of certain portions of different river systems, *independent* of relationship, and vice versa. The negroes of Kordofan are nearer in descent to the Copts and Arabs, than are the light-coloured and more civilised Fulahs. They are also nearer to the same, than they are to the blacks of Senegambia. If this be the case, the term has no place in ethnology, except so far as its extensive use makes it hard to abandon. Few writers are less disposed to account for ethnological differences, by reference to a change of physical conditions, rather than original distinction of species, than Dr. Daniel; nevertheless, he expressly states that when you leave the low swamps of the delta of the Niger for the sandstone country of the interior, the skin becomes fairer, and black becomes brown, and brown yellow. The Nubians or the natives of the middle Nile, between Egypt and Senaar, are truly transitional in features between the Egyptians and the blacks of Kordofan. Again, Dr. Morton's pages afford abundant evidence of the constant blending of forms in small areas, and the equally constant extinction of some by the preponderance and supremacy of others. At this very time the European population of South America is, according to Squiers, undergoing rapid absorption by the imported Carib Indian blood which now predominates; the new race partaking, in a minor degree, of the European impress. Before, however, we leave this part of the subject, to enquire into its time and space aspect, we would direct attention to the fact that, at the present all nations are tending more and more towards each other; the facilities of travel and the necessities of man cause a more rapid intercourse between families, and in the same manner that the European type has blended—leaving the primary settlers to be sought in stationary areas—so will there ultimately be a blending and fusion of the whole race or family. Is there a "centre of creation" for the criminal population of the large and overcrowded cities of the old world? In one sense there certainly is, but it is centralisation produced by forced association. Transport the felons and other convict classes of Europe to a single spot; leave them in isolation and to the lawless indulgence of their passions and inclinations, and what physiologist will declare that the savage type of cranium will not be handed down from generation to generation? and this is precisely the history of the human family! Broken up and dispersed abroad for nearly seven thousand years, one part of mankind has passed through stages of civilisation and religious enlightenment, the other through as many corresponding degrees of degradation and immorality;

and in proportion to the degradation and to the quality of the mind, is the conformation of the organ of its faculties.

There are, however, two most important physiological laws, which seem to point conclusively to the unity of the species, and sufficiently to account for variety, which have been strangely overlooked by Dr. Meigs in the late work, "Indigenous Races of Mankind"; quoting Mr. Lawrence, he says, "There is, on the whole, an undeniable amount of evidence, nay, a very remarkable constancy of character in the crania of different nations, contributing very essentially to national peculiarities of form, and corresponding exactly to the features which characterise such nations." Nor, says Meigs, does this fact stand alone. It is associated with another, which should never be lost sight of in all our speculations upon the unity or diversity, geographical origin and distribution, affiliation and antiquity of the races of men. I allude to that *insensible gradation which appears to be the law of human forms*, no less than of all the objects in nature.* From the isolation and exclusive consideration of these facts, have resulted not a few erroneous assertions, which have tended to embarrass the science. Thus, it has been considered in general a matter of but little

* It is to be remembered that this gradation "in all objects of nature" has to be sought in the whole plan, sometimes the link being in a past creation. In man the gradation constantly exists, although the grades may vary.

difficulty to discriminate between the crania of different races. Those who are accustomed to this kind of examination, know that this statement is true only for the *standard* or typical forms of very diverse races; and that as soon as certain divergent forms of two allied races or families are compared, the difficulties become very apparent. On the other hand, it has been affirmed that, in any one nation, it is easy to point out entirely dissimilar types of configuration. Prof. J. M. Weber, arrives at the general conclusion, that there is no proper mark of a definite race-form of the cranium so firmly attached, that it may not be found in some other race. The assumption of the universality of certain ethnical forms, though countenanced by more than one writer, does not rest upon sufficient evidence to warrant its acceptance. Another prevalent, but equally gratuitous notion is, that the more ancient the heads, the more they tend to approximate to one primitive form or type. With regard to the law which we are never to lose sight of, we would ask, can there be a more powerful argument in favour of actual blood relationship, than the simple fact of "*insensible* gradation," not only in family form and likeness, but also in the whole man—body, soul, and spirit? Unlike the gradation which is said to be observable between the horse, the quagga, the zebra and the ass, the gradation in the varied family of man is positively insensible, and relates as well to his physical as to his psychical condition. The difference observable between the horse and the ass, for instance, are manifested first in the greater power of adaptation in the former to various climatal changes —horizontal and vertical—now having his form expanded to the size almost of the elephant, again dwarfed down to that of a sheep. The other is stationary almost in its developement, and in Spain has been most improved, but the improvement is not to be compared to that effected in the horse. Again, the union of the horse and ass produces a progeny which is, as a general law, sterile and incapable of producing or perpetuating its kind. This is so far from being the case in man, that in every instance improvement follows free intercourse between the severed stocks. Dr. Morton's book is full of instances, and every writer testifies to the same fact: thus, at page 10, speaking of the Persians, it is said, "It is chiefly among the mountain tribes (being more isolated) that the indigenous Persian is now found. In the towns, the inhabitants present a different aspect; for the long admixture of Georgian and Circassian blood has done much to improve the Tartar physiognomy of the rural tribes, and the somewhat heavy figures and sallow colour of the original Persians." Again, "The Iliyats or wandering tribes of Persia are chiefly of exotic extraction, and form a distinct body of people. Morier compares them to foreign shoots, grafted on the original Persian stock. They date from the conquest by the Saracens, A. D. 651, and their numbers were augmented during the subsequent invasions of Genghiz and Tamerlane. They are of Mongol Tartar extraction, but have mingled for centuries with the Persians, to whom they have imparted their roving propensities." Again, "During the period of the Roman greatness, the colonies of Greece and Rome extended themselves widely into Spain, where they blended with the primitive Celtabrians or Basques, and the Phœnicians. The later invasions of the Vandal and Saracens have *added their diversities* to the *physical* and *moral* character of the Spaniard, which, with some redeeming qualities, has the selfishness of the Arab, the cruelty of the Roman, and the superstition of the Greek." And precisely the same general facts apply to the African diversities and their Asiatic neighbours; every where, even among people inhabiting the same continent, and among those of the same nation, gradational links are seen. We know where the true negro is to be found; do we know where his connexion with others terminates? It is true that, at the present time, the primitive ethnical form cannot be determined; but this much is certain, that the cranium is the index of the entire economy; for the relation between the cranium on the one hand, and the face, thorax and abdominal organs on the other, or, in other words, as is the cerebral or intellectual lobes of the brain and the sensory ganglia and nerves, so is the relation of mental powers to animal propensities; and exactly upon this relation depends the nature and character of the individual man, and the family groups to which he naturally belongs. Examples, observes Meigs, of this fact are every where to be found, alike in the *transitionary*, as in the more stationary specimens of the human series. It is a general and well-marked truth, that in those inferior races—the so-called prognathous—characterised by a narrow skull, receding forehead, and enormous anterior developement of the maxillæ, the mental are in entire abeyance to the animal powers; so that their sensuality is only equalled by their stupidity, as one might readily infer *from the ample* accommodation for the organs of the senses. The pyramidal type is another inferior form, singularly analogous to the prognathous in many respects, but differing from it in others. Races possessing this form of cranium, manifest corresponding peculiarities in intellectual power. If then the brain be an organ which, constructed on the plan of other organs of the animal body, increases in size and power by the healthy performance and exercise of its functions, is it not a necessary result that the cranium should indicate the mental and moral condition of the race, in accordance with the exercise which the organ undergoes? With regard to the second law, referred to by Dr. Meigs, that "resemblances in cranial form and characteristics do not necessarily betoken congenital affiliations," we entirely agree; but does it not prove the stability of another law in physiology, which is commonly apparent in family groups, viz., that there is a constant tendency (as has been already pointed out) to a return to primitive peculiarities? For it is certain that, although the characteristics of an ancestor may not appear in one generation, they do occur in some succeeding one; and what is true of the family, is true of the nation; and if we do find coincident forms, while there may be no immediate relationship, it tends to shew that there is a community of origin, although how remote we may never discover—dissimilarity does not prove disunion. Dr. Latham, in his "Varieties of the Human Species," gives an admirable illustration how, in the same people, we may have varied characteristics, apparently partaking of the peculiarities which may exist in two families. If, says Dr. Latham, we examine the details of the geographical area occupied by the Esquimaux, its direction is *double*. The Esquimaux of the Atlantic are not only easily distinguished from the tribes of American aborigines which lie to the south or west of them, and with which they come in contact, but they stand in strong contrast and opposition to them—a contrast and opposition exhibited equally in appearance, manners, and language, and one which has had full justice done to it by those who have written on the subject. It is not so with the Esquimaux of Russian America and the parts that look on the Pacific. *These* are so far from being separated by any broad and trenchant line of demarcation from the proper Indians, or the so-called red race, *that they pass gradually into it;* and that, in respect to their habit, manner, and appearance, equally. So far is this the case, that he would be a bold man who should venture, in speaking of the southern tribes of Russian America, to say, *here the Esquimaux area* ends, and here a different area begins. Similar observations are made by African travellers, who repeatedly describe, not only varieties in some tribes, but also the existence of intermediate types, which seem to blend the characteristics of the true negro and some other African form, and insensibly to connect all forms.

Another assertion is, "*that a type, as it is manifested in nature, is for all practical purposes fixed and immutable.*"

It depends entirely on the meaning of the term, as to the kind of answer to be given. If it be meant that the immutability shall include, not only form, but life powers also, we may subscribe to the general truthfulness of the laws. Thus, the horse, whether he be the proud, high-blooded racer, the elephant dray-horse, or the Shetland poney, is yet of the same type. The zebra or the ass is always the same with varieties admitted to be such. So we affirm it to be with man—as man can never be any thing else, although his physical character may oscillate between two points, the intermediate space being occupied by varieties which are gradational. The organs which are modified in him, are precisely those which altered circumstances are efficient to account for, and it is only possible to retain peculiarities in his varied members by most careful isolation, for no sooner does a new family enter on the area of the old one than transition begins. Arrest of developement is noticed in all the savage races; and the exceptions amongst them establish the fact, that under favourable conditions their brains would undergo the same developement as those of enlightened people. The American family furnish illustrations of this fact, and among the negro family similar examples may be found: thus, the old chief Red Jacket, amongst others, tells how the forehead may be expanded and elevated to the measure of intellectual standard. The illustration of the head of an Indian child about eight years of age, taken from a mound at Berwick, near Weston, and twenty miles north-west of Toronto, (see wood-cut, page 520,) shews that neither the receding forehead or occiput are in this case greater than in a European of similar age, although the hereditary type is beginning to display itself in the prominence of the cheek-bones.

The objectors to the doctrine of unity of the human family adduce as a strong argument against it, that the early appearance of the negro physiognomy on the monumental tablets of Egypt render it impossible to suppose that the change could have been effected in so brief a space. Few of us can really appreciate the actual duration of eight thousand years.* In noticing the changes, some observers

* What may have been the date which the Egyptians assigned to the creation and the deluge? The day of the creation was, according to their traditions, the day of the vernal equinox, as Philo and the Church Fathers testify. The said planetary constellation of the commencement of the first age of the world, also preserved by the Egyptians, refers us, as we have already shewn, to the same day, the vernal equinox of the year 5871 B. C. Furthermore, they placed the creation in the year in which Sirius, the dog-star, rose together with the sun, on the day of the vernal equinox, as we are informed by Porphyry, by Æneas Gazæus and others. And this again could take place only in the year 5871 B. C. Lastly, we find it stated by the Alexandrian astronomer Theon, that in the year 27 B. C., the sixteenth of the reign of Augustus, on the 29th of August (the first of the month Thoth) a new canicular period (the fifth since the creation, comprising 1461 years) had commenced; by which 5871 B. C. is again confirmed as the year of the creation. In short, the Egyptians, like all the other nations of antiquity, have assigned 5871 B. C. as the year of the creation. The history of the deluge they represented by the myth concerning the death of Osiris, which occurred on the same day, the 17th of the month Athyr, on which the flood began, according to the sacred Scriptures.

But how does this agree with Matheno and the Vetus Chronicon, which reckon 30,000 years from the beginning of time to TyPhon, the murderer of his brother Osiris (*i. e.* to the flood; for Typhon signifies also the sea, as Osiris the mainland); and, farther, 3984 years from thence to Menes, and besides 217 additional years? We are informed by Censorinus, Horapollo and others, that the Egyptian word *abot, habot,* (complexus) signified not only a year, but also a month, and also a season of two months. Consequently Manetho and the author of the Vetus Chronicon were authorised to calculate times according to such shorter years, without contradicting the other historical traditions of their nation. Now we know, moreover, that Manetho's history of Egypt was called the book of the Sothis, that is to say, the book of the great canicular period of 36,525 years. This number was obtained by the multiplication of the smaller Sothis of 1461 years with the Apis-period of twenty-five years, and proximately coincided, as we have seen, with the great world-period of 36,000 years. Now since Manetho was very well acquainted with the very year of the creation, 5871 B. C., which was recorded in the planetary constellations concerning the commencements of the three first ages of the world, he must have taken shorter years as the basis of those periods, of 30,000 and 3984 years, in order to include in his great Sothis of 36,525 years the entire history of Egypt down to his time. In short, for the purpose of establishing a history of 36,525 years, called Sothis, Manetho turned solar years into months dogmatising on the fact, declare that man has been on the earth a much greater time, and much more nearly thirty thousand years; while more careful enquirers after truth give positive contradiction to such statements. Now, taking, as we may fairly do, the period of time stated by Seyffarth and Osburn to have elapsed since the Noahic deluge, we find that decided changes have taken place in the race of man; the evidence is clear and decisive, and what has to be reconciled is the fact that such change has been produced in limited time.

We have already alluded to the fact, that the change of the Egyptian cranium in that ancient people, as discovered to us by their monuments, was preceded by a family bearing different characteristics, and by the present becoming a more and more diverse type, approaching the European family, as the Turk is doing. That the greatest caution is required in drawing conclusions from the

by multiplication, as we find it also among the ancient Chaldeans, Hindoos, Chinese, and others. He therefore regarded those 30,000 years of his from the creation to the flood as so many lunar months, (abot) and consequently reckoned only 2424 solar years for the period in question. Moreover the 3984 years, (Horæ) from the deluge to Menes, of which each expressed a season of two months, give but 664 solar years; and Manetho's third period of 217 years, rather comprises the days from Menes' departure from Babylonia to his arrival in Egypt.

Hence there is nothing at all irreconcilable between Manetho's Sothis and the other traditions of his people. All knew that, according to the above-mentioned planetary configurations, the creation had taken place on the 10th of May, 5871 B. C., and the arrival of Menes on the 16th of July, 2871 B. C. Between the two epochs 3989 years intervene, and precisely this number we have in Manetho's periods of 30,000 months and 3984 Horæ, with 217 days. In fine, as Manetho reckons from the creation down to Typhon (the deluge) 2424 solar years, the Egyptians placed the flood 2424 years subsequent to 5871 B. C., and therefore in the year 3447 B. C., to which year, as has already been said, the planetary configuration in the alphabet refers.

shapes of crania, is well illustrated by Dr. Morton; and we turn to the instance of "Peruvian skull" for information on this head, and there we find just the sort of evidence which the careless investigator may twist and turn to his purpose, unless governed by a stern love of truth. In examining the grave-yards of the ancient Peruvians, Dr. Morton and others discovered certain skulls so flattened that they assumed the shape and form of those of the common domestic cat; and it was supposed, after close examination, that this form was produced by artificial means, since a very large number of savage tribes do, even to this day, from the Flat-heads of North America to the Carib of San Vincent, practise this absurd art. Recently a Danish savan, Dr. Lund, has re-opened the question, stating certain reasons for believing that the type is not artificial, but native. Let us examine into the validity of his conclusion. Dr. Lund remarks: "We know that human figures found sculptured in the ancient monuments of Mexico represent, for the greater part, a singular conformation of head, being entirely without forehead, the cranium retreating backwards immediately above the superciliary arch. This anomaly, which is generally attributed to an artificial disfigurement of the head, or the taste of the artist, now admits a more natural explanation: it being now proved by these authentic documents, that there really existed on the continent a race exhibiting this anomalous conformation." Meigs, in commenting on this, observes: Many curious facts might be mentioned in this connexion, shewing that not a few of the artificial deformations of the head witnessed in certain races of them, are in reality imitations of once natural types. We know, says Amedee Thierry, that the Huns used artificial means for giving Mongolian physiognomy to their children; they flattened the nose with firmly-strained linen ribbons, and pressed the head to make the cheek-bones projecting. What could be the reasonable cause of this barbarous custom, if not the effort to approach a form which, among the Huns, was held in greater regard; in a word, the aristocratic race? Now if we compare the figures of Egyptian heads on the bas-reliefs, we shall find that the receding forehead is very well depicted; and in the sculptures of Central America, drawn by Squiers, we have the same flattening of the head. Was this custom, so common in the unwritten history of the human race, an imitated peculiarity; or does it point to races of flat-headed men, springing up at different centres of creation? Can any reasonable mind come to any other conclusion, than that which the just mode of weighing evidence would point out; that if there be evidence of imitation, there must have been a copy to imitate? It is curious as well as instructive to compare the remarks of two distinguished historians on this point. Torquemada, writing of the Peruvians, says, "As to the custom of appearing fierce in war, it was in some provinces ordered that the mother or their attendants should make the faces of their children long and rough, and their foreheads broad; as Hippocrates and Galen relate of Macrocephali, who had them moulded by art into the elevated and conical form." We see in this evidence of imitation, and it affords incidental proof of that oneness of the family which it is well to bear in mind. Since the publication of Lund's opinion, Dr. Morton has examined the whole question, and concludes that the cause of the deformity is compression. I have remarked, he says, that if we had no other evidence of this strange custom than the narration of travellers, we might be disposed to deny it altogether, and attribute the resulting deformities—not to art, but to some original and congenital peculiarity. I at first found it difficult to conceive that the original rounded skull of the Indian could be changed into this fantastic form, and was led to suppose that the latter was an artificial elongation of a head remarkable for its natural length and narrowness. I even supposed that the long-headed Peruvians were a more ancient people than the Inca tribes, and distinguished from them by their cranial configuration. In this opinion I was mistaken. Abundant means of observation and comparison have since convinced me that all these variously-formed heads were originally of the same rounded shape, which is characteristic of the aboriginal race from Cape Horn to Canada, and that art alone has caused the diversities. It was also remarked of the ancient Aymacas—lake Titicacca—that those skulls which were flattened were uniformly those of men. So far, then, from accepting Dr. Meig's conclusions, we must assume that there is not ground for the belief in an original flat-headed race ; but abundant reason to accept the doctrine that the practice was an artificial one, and may have been imitative of a custom common in ancient times.

In considering the changes noted in the human family, the element, time, is much insisted on, and the endeavour is constantly made to push back the origin of man to an almost indefinite extent. Dr. Lund avails himself of the cave-remains of Brazil to prove this point: on the contrary, we believe that they rather establish his recent origin.

That changes have taken place in the surface of the earth, since the origin of the human period, there is evidence to shew. Humboldt, in his wanderings in the interior of Guiana, and Wilson, in his "Pre-historic Annals of Scotland," have well illustrated the fact. The former author says, "Schomburgh has described a cascade on the banks of the Essequibo, near the cascades of Warraputa, which, he says, is celebrated not only for its height, but also for the quantity of figures cut in the rock, which have a great resemblance to genuine Carib ones in one of the small Virgin Islands (St. John's); but notwithstanding the wide extent of the invasion of the Caribs, and the ancient power of this fine race, I cannot believe that all the rock engravings, which form an immense belt, traversing a great part of South America from west to east, are to be regarded as their work. Between Encaramada and Caycara, on the banks of the Oronoco, a number of these hieroglyphical figures are sculptured on the face of precipices, at a height which could now be reached only by means of extraordinary high scaffolding. If one asks the natives how these figures can have been cut, they answer, laughing—as if it were a fact of which a white man alone could be ignorant, 'that in the days of the great waters, their fathers went in canoes at that height.' Although not absolute proof, the height of these sculptures, and the tradition of a large river or lake flowing at the base of the lofty rocks, would seem to indicate a great change in this region of country."

Of the remains of man himself, we have the following instances furnished by Agassiz, Lund, and Mantell. The former writer says, "The fossil remains of the human body from Florida, that I possess, were discovered in a *bluff upon the shores* of lake Monroe. The mass in which they were found is a conglomerate of *rotten coral-reef, limestone, and shells*, mostly ampularia *of the same species* now found in the St. John's river, which drains lake Monroe. The question of their age is difficult to answer. The point to settle is the rate of increase of the peninsula of Florida, in its southward progress. If we *assume* from evidence we now have, of the additions forming upon the reefs and keys, the rate of growth to be one foot in a century, it would require one hundred and thirty-five thousand years to form the southern half of the peninsula. *Assuming*, further, that the northern half of the peninsula already formed, continued for nine-tenths of that time a desert waste, before the fossiliferous conglomerate could be formed, there would still remain ten thousand years, during which it should be admitted that the main land was inhabited by man." Every thing in this case is based on *assumptions*, and Mr. Lyell's "Law of Uniformity" is taken as proven, while some of the very ablest geologists have shewn its utter fallacy. Again, it is not a little remarkable th[illegible] all Prof. Agassiz' ingenuity, he comes up [illegible] to the dates which some of the chrono[illegible] assign to man's advent, making the difference between Agassiz, Seyffarth, Osburn and others somewhere from one to two thousand years; while, as we shall point out, authorities superior to Agassiz on points of pure geology, are decidedly against him.

Mr. Mantell has given illustrations of the fossil remains of man, which are very interesting; and, as the result of his investigations, concludes, that there is no evidence of their being so ancient as some sceptics imagine. After describing the rapidity of some formations in the West Indies and Scotland, he says: The shores of the Bermuda Islands afford interesting examples of this class of deposits in different states of consolidation. The sea surrounding the Bermudas abounds in corals and shells; and from the action of the waves on the reefs and on the dead shells, the water becomes loaded with calcareous matter. Much of the detritus is transported to a distance, and subsides in the depths of the ocean, imbedding the remains of animals and vegetables; but a great portion is borne by the waves towards the shores, and cast up on the strand in the state of fine earth and sand. This detritus is blown inland by the winds, and is soon consolidated by the percolation of water and the infiltration of crystallized carbonate of lime; a fine white calcareous stone is thus formed, which in some localities forms the dripstone or filter-stone, and sometimes is sufficiently compact for building. In this rock are numerous shells and corals, of species which inhabit the neighbouring seas; in some instances the large mottled turbo, so well known to collectors both in its natural and polished state, with all its colours preserved, is imbedded in a pure white limestone. In many specimens the colours are faded, and the shells very much in the state of those found in the tertiary strata at Grignon; in others the shell matter is wanting, but the hard stone retains the forms and markings of the originals. The corals are imbedded in a similar manner; and masses occur in the limestone so like the fossil corals of the oolite of this country, that it requires an experienced eye to detect their real nature. In a suite of specimens, shewing the transition from loose sand to solid rock, we have—

1. Broken shells and corals, retaining their colours.

2. Similar materials, more comminuted and completely bleached.

3. An aggregation of fine sand and white earth, broken shells, and corals.

4. Friable limestone, resembling soft chalk, and composed of comminuted corals, corallines, &c.

5. Hard limestone, of similar materials.

6. Compact limestone, enveloping shells and pebbles.

7. A fine indurated limestone, so hard as to be with difficulty broken by the hammer, enclosing a few shells and corals: this stone is employed for building.

The Bahamas, and others of the West Indian Islands, mainly consist of similar coral-deposits. Some of the indurated coral-sands occasionally contain eggs of alligators and of turtles.

In the lakes of Forfarshire, in Scotland, fresh-water limestone, containing recent shells and aquatic plants, is in progress of formation. In the specimens collected by Sir C. Lyell, are various species of fresh-water shells, and masses of that common fresh-water plant, the *chara medicaginula*, beautifully preserved; even the minute seed-vessels of the chara are converted into stone, in precisely the same manner as those in the ancient fresh-water tertiary limestones. Here, then, is an example of the formation of a modern lacustrine rock; while, in the recent limestones of Bermuda, we have proof that the sea is at this time forming shelly and coralline rocks, analogous to many of the ancient secondary strata.

Similar aggregations are in progress along the shores of the whole West Indian archipelago; and in St. Domingo they have greatly extended the plain of Cayes, where accumulations of conglomerate occur, and in which, at the depth of twenty feet, fragments of ancient pottery have been discovered. On the north-east coast of the mainland of Guadaloupe, a bed of recent limestone forms a sloping bank from the steep cliffs of the island to the sea, and is nearly all submerged at high tides. This modern rock is composed of consolidated sand and comminuted shells and corals of species now inhabiting the adjacent seas: land-shells, fragments of pottery, stone arrow-heads, carved stone and wooden ornaments, and human skeletons, are occasionally found imbedded in it. This circumstance, being the first known undoubted example of the occurrence of human bones in solid limestone, excited great attention; and the fact, simple and self-evident as is its explanation, was made the foundation of many vague and absurd hypotheses.

In most instances the bones are dispersed; but a large slab of rock, in which a considerable portion of the skeleton of a female is imbedded, is preserved in the British Museum, and has been described by Mr. Konig, in a highly interesting memoir, published in the Philosophical Transactions of 1814. The annexed representation will convey an idea of this celebrated relic, which was detached from the rock at the mole, near Point-a-Pitre.

In this specimen the skull is wanting, but the spinal column, many of the ribs, and the bones of the left arm and hand, of the pelvis, and of the thighs and legs, remain. The bones still contain some animal matter, and the whole of their phosphate of lime. It is remarkable, that the fragments of the skull of this very specimen have recently been purchased, for the museum at South Carolina, from a French naturalist, who brought them from Guadaloupe; and they have been described by Pro-

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fessor Moultrie, of the Medical College of that State. These relics consist of portions of the temporal, parietal, frontal, sphenoidal, and inferior maxillary bones of the right side of the skull. An entire skeleton was also discovered in the usual position of burial; and another, in a sitting posture, in a softer sandstone. The bodies, thus differently situated, may have belonged to distinct tribes. General Ernouf, who carefully investigated this interesting deposit, conjectured that the presence of the bones might be explained by the circumstance of a battle, and the massacre of a tribe of Gallibis by the Caribs, which took place near this spot, about one hundred and twenty years ago; for, as the bodies of the slain were interred on the sea-shore, their skeletons may have subsequently been covered by sand-drift, which has since consolidated into limestone. Dr. Moultrie, however, from a rigorous examination and comparison of the bones of the skull in his possession, is of opinion that the specimen in the British Museum did not belong to an individual of the Carib, but to one of the Peruvian race, or of a tribe possessing a similar craniological developement.

In another skeleton from Guadaloupe, now in the museum of the Jardin des Plantes, and represented in the last edition of Cuvier's "Theorie de la Terre," the figure is bent, the spine forms an arc, and the thighs are drawn up as if the individual were in a sitting posture; a portion of the upper jaw, and the left half of the lower with several teeth, nearly the whole of one side of the trunk and pelvis, and a considerable portion of the upper and lower left extremities are preserved. The stone encloses terrestrial and marine shells ; it is evident that the former have been drifted by streams from the interior, and the latter deposited by the sea. In the bed from which this block was extracted, were found teeth of the caiman, (a species of crocodile) stone hatchets, and a piece of wood, having rudely sculptured on one side a mask, and on the other the figure of an enormous frog ; it is of guaiacum, but has become extremely hard, and as black as jet.

Human skeletons have also been found in solid calcareous tufa, near Santa, in Peru. Bones, belonging, it is computed, to some scores of individuals, were discovered imbedded in travertine, containing fragments of marine shells, which still possess colour. The bed of stone is covered by a deep vegetable soil, and forms the face of a hill crowned with brushwood and large trees, on the one side of the river Santa.

In the Isle of Ascension, which is a volcanic cone in the midst of the Atlantic, and appears to have been a dome of trachytic rocks, subsequently affording vent to lava-currents, a recent deposit of conglomerate is going on. Its coasts are flanked by accumulations of concreted sand with comminuted shells, corals, echini, and fragments of lava. The specimens before us are portions of this modern rock in various states of consolidation; they are composed of corals, which still retain their colour, of shells, more or less broken, and of sand of similar materials; they also contain pebbles of trachytic and glassy lava. The shores of this island are a favourite resort of turtles, which repair thither in immense numbers, and deposit their eggs in the loose sand: the rapid conversion of the coarse calcareous banks into solid stone, occasions the frequent imbedding and preservation of the eggs; and there are specimens in the cabinet of the Geological Society, in which the bones of young turtles, just on the point of being hatched, are preserved. The conglomerate of the Isle of Ascension is, as you may observe, principally composed of corals. Here we have another example of a rock formed of the calcareous skeletons of those wonderful forms of organic existence; but it is not my intention in this place to dwell on the geological changes produced by zoophytes in the formation of coral-reefs, &c.

We have already alluded to the encroachments on the land by the drifting of sand-banks, thrown up beyond the reach of the tide, and driven by the winds inland; thus effecting the desolation of whole regions by their slow but certain progress. Egypt instantly presents herself to the imagination, with her stupendous pyramids, the sepulchres of a mighty race of monarchs, and the wonder of the world—her temples and palaces, once so splendid and massive as to bid defiance to the ravages of time—her plains and valleys, formerly teeming with abundance and supporting a numerous population—now stripped of her ancient glories, her fairest regions depopulated, and converted into arid wastes,—her cities overwhelmed and prostrate in the dust,—and the colossal monuments of her kings and the temples of her gods half buried beneath the sands of the desert!

The drifting sands of the Libyan desert by the westerly winds, observes M. De Luc, have left no lands capable of cultivation on those parts of the western bank of the Nile, whole districts are covered by moveable sands, and here and there may be seen the summits of temples and the ruins of cities which they have overwhelmed. "Nothing can be more melancholy," says Denon, "than to walk over villages swallowed up by the sand of the desert, to trample under foot their roofs and minarets, and to reflect that yonder were cultivated fields, that there grew trees, that here were the dwellings of men, and that all have now vanished. The sands of the desert were in ancient times remote from Egypt; and the oases which still appear in the midst of this stertile region are the remains of fertile soils which formerly extended to the Nile."

In the maritime plains and valleys of Peru the same cause is operating slowly, but with unremitting energy; the sea-sands are marching incessantly before the trade-wind, and threaten ultimate desolation. The sand has already surmounted the lofty hills which form the southern boundary of the beautiful valley of Lurin, and is flowing down in large waves over the cultivated ground. The same phenomenon is observable on the elevated plain which is called the Tablada, where the tops of the hills appear like Egyptian oases, and whence the sand is pouring down in enormous floods over the sugar-plantations of San Juan and Villa, in the valley of Rimac.

On many parts of the shores of Scotland, sand-floods have converted tracts of great fertility into barren wastes ; and on the northern coast of Cornwall an extensive district has been covered by drifted sand, which has become consolidated by the percolation of water holding iron in solution, and in some places forms ranges of low mounds, and hills forty feet high.

From a memoir by Dr. Paris, in the transactions of the Royal Geological Society of Cornwall, we find that a sandstone occurs in various parts of the northern coast of Cornwall, which affords a most instructive example of a recent formation, since we here actually detect nature at work in converting loose sand into solid rock. A very considerable portion of the northern coast of Cornwall is covered with calcareous sand, consisting of minute particles of comminuted shells, which, in some places, has accumulated in quantities so great, as to have formed hills of from forty to sixty feet in elevation. In digging into these sand-hills, or upon the occasional removal of some part of them by the winds, the remains of houses may be seen ; and in places, where churchyards have been overwhelmed, a great number of human bones may be found. The sand is supposed to have been originally brought from the sea by hurricanes, probably at a remote period. At the present moment, the progress of its incursion is arrested by the growth of the *arundo arenacea.* The sand first appears in a slight but increasing state of aggregation on several parts of the shore in the Bay of St. Ives ; but on approaching the Gwythian River, it becomes more extensive and indurated. On the shore opposite Godrevy Island, an immense mass of it occurs, of more than a hundred feet in length, and from ten to twenty in depth, containing entire shells and fragments of clay-slate ; it is singular that the whole mass assumes a striking appearance of stratification. In some places it appears that attempts have been made to separate it, probably for the purpose of building, for several old houses in Gwythian are built of it. The rocks in the vicinity of this recent formation in the Bay of St. Ives are greenstone and clay-slate, alternating with each other. The clay-slate is in a state of rapid decomposition, in consequence of which large masses of the horn-blend rock have fallen in various directions, and given a singular character of picturesque rudeness to the scene. This is remarkable in the rocks which constitute Godrevy Island. It is around the promontory of New Kaye that the most extensive formation of sandstone takes place. Here it may be seen in different stages of induration, from a state in which it is too friable to be detached from the rock upon which it reposes, to a hardness so considerable that it requires a very violent blow from a sledge to break it. Buildings are here constructed of it; the church of Cranstock is entirely built with it; and it is also employed for various articles of domestic and agricultural uses. The geologist who has previously examined the celebrated specimen from Guadaloupe will be struck with the great analogy which it bears to this formation. Suspecting that masses might be found containing human bones, if a diligent search were made in the vicinity of those cemeteries which have been overwhelmed, I made some investigations in those spots, but, I regret to add, without success. The rocks upon which the sandstone reposes are alternations of clay-slate and slaty limestone. The inclination of the beds is S.S., and at an angle of 40°. Upon a plane formed by the edges of these strata, lies a horizontal bed of rounded pebbles, cemented together by the sandstone which is deposited immediately above them, forming a bed of from ten to twelve feet in thickness, containing fragments of slate and entire shells, and exhibiting the same appearance of stratification as that noticed in St. Ives' Bay. Above this sandstone lie immense heaps of drifted sand. But it is on the western side of the promontory of New Kaye, in Fishel Bay, that the geologist will be most struck with this formation; for here no other rock is in sight. The cliffs, which are high and [illegible]d for several miles, are entirely composed [illegible] they are occasionally intersected by veins and [illegible]es of breccia. In the cavities, calcareous stalactites of rude appearance, opaque, and of a grey colour, hang suspended. The beach is covered with disjointed fragments, which have been detached from the cliffs above, many of which weigh two or three tons.

An interesting fact relating to the Brazilian caves is worthy of record. M. Claussen, in the course of his researches, discovered a cavern, the stalagmitic floor of which was entire. On penetrating the sparry crust he found the usual ossiferous bed, but pressing engagements compelled him to leave the deposit unexplored. After an interval of some years M. Claussen again visited the cavern, and found the excavation he had made completely filled up with stalagmite, the floor being as entire as on his first entrance. On breaking through this newly-formed incrustation, it was found to be distinctly marked with lines of dark-coloured sediment, alternating with the crystalline stalactite. Reasoning on the

probable cause of this appearance, M. Claussen sagaciously concluded that it arose from the alternation of the wet and dry seasons. During the drought of summer, the sand and dust of the parched land were wafted into the caves and fissures, and this earthy layer was covered during the rainy season by stalagmite, from the water that percolated through the limestone, and deposited calc-spar on the floor. The number of alternate layers of spar and sediment tallied with the years that had elapsed since his first visit; and on breaking up the ancient bed of stalagmite, he found the same natural register of the annual variation of the seasons; every layer dug through presented a uniform alternation of sediment and spar: and as the botanist ascertains the age of an ancient dicotyledonous tree from the annual circles of growth, in like manner the geologist attempted to calculate the period that had elapsed since the commencement of these ossiferous deposits of the cave; and although the inference, from want of time and means to conduct the enquiry with precision, can only be accepted as a rough calculation, yet it is interesting to learn, that the time indicated by this natural chronometer, since the extinct mammalian forms were interred, amounted to many thousand years.

As in the bone-caves of England, France, and Germany, relics of human skeletons have been found in the upper layers of the detritus forming the floor of the Brazilian caves. Dr. Lund, from the condition and situation of these remains, concluded that they belonged to an ancient tribe that was coeval with some of the extinct mammalia.

The facts which have been accumulated by the most laborious industry, and not always commented on with the most scrupulous impartiality, all, nevertheless, conspire to establish the recent advent of man upon the earth, at the head of the present creation; and thus to identify him not only as closely connected with the last age of Creative Energy, but as the being in whom is summed up the love and glory of the Creator. Not only in man do we discover that perfection in external form, that wonderful mechanism which places him above his associate creatures; but beyond all this is revealed to us the creation of a Moral World, with its grand and sublime duties, which lift him up to association with spirits, which we feel and are conscious must be partakers of a state of existence, which our own yearnings prompt us to regard as alone worthy to be enjoyed by creatures gifted with faculties such as we possess. It is a matter of deep concern to the theist, and, above all, to the christian, to feel and know that accumulating proofs attest the truth of man's later creation, and conspire, with the judgments of the naturalist, to place him at the head of earth's marvels; and yet a step further, when the records of written history seem to have been silent, the imperishable monuments of a long past age yield up their mysterious testimony to the truthfulness of that written history, which a large portion of the most enlightened receive as the revelation of the Holy One. But we not only find the strongest reasons for accepting the history of man's comparatively recent origin; there is every reason to acknowledge that there is but one flesh, that the Great Father of All hath made, of one blood, all the nations upon earth, and hath bound them in one bond of fellowship.

Mr. Mantell observes that in Europe, the first appearance of man, as indicated by the remains of human skeletons and works of art, was immediately after the great inundation which spread the rolled boulders and detritus of the drift or diluvium over the valleys and plains, and into the caverns and fissures in which the bones of the mammalia that inhabited the land are found entombed. What species, now extinct, were existing at the period of the first advent of the human race into Europe, it is scarcely possible to determine. The Irish elk, two or three species of bos, and probably a species of horse, beaver, and bear, are apparently the only lost forms which the facts at present known point out as contemporaries of the aboriginal tribes of the British Islands and the neighbouring continent.* In the ancient tertiary strata, though the bones of many

* With Prof. Owen, we believe that even these animals were not contemporary with man.

species of quadrupeds of existing genera, and even some species believed to be identical, abound, yet no vestiges of man or of his works have been detected. While, therefore, we may reasonably expect to find fossil human remains in strata of higher antiquity than any in which they have hitherto been observed, it does not seem probable that traces of man's existence will be met with in the eocene, or ancient tertiary formations; for, notwithstanding the occurrence of existing genera and species of mammalia, even of that race which approaches nearest to man in its physical organisation—the quadrumana or monkey tribes—there are no just grounds for assuming that physical evidence will be obtained by which the existence of man, and, consequently, of the present order of things, may be traced back to that remote era.

In reference to this problem, I entirely concur in the opinion expressed by Prof. Whewell, "that the gradation in form between man and other animals is but a slight and unimportant feature in contemplating the great subject of the origin of the human race. Even if we had not revelation to guide us, it would be most unphilosophical to attempt to trace back the history of man, without taking into account the most remarkable facts in his nature; the facts of civilisation, arts, government, speech; his traditions; his internal wants; his intellectual, moral, and religious constitution. If we will attempt a retrospect, we must look at all these things as evidence of the origin and end of man's being; and when we do thus comprehend in one view the whole of the argument, it is impossible for us to arrive at an origin homogeneous with the present order of things. On this subject the geologist may therefore be well content to close the volume of the earth's physical history, and open that divine record which has for its subject the moral and religious nature of man."*

In the previous portion of this book we have endeavoured to illustrate, both from the anatomical conformation of the brain of animals, as well as that of man, that it is the instrument by which the mind is enabled to hold converse with the external world, and to appreciate and reflect upon external objects. In accordance with the development of the organ, and even in proportion to the perfection of its parts—as, for instance, in the case of the elephant, whose cerebrum is more convoluted and better arranged than that of the ape, although the whole type of brain of the latter is nearer to that of man—so is man able to understand and perceive external relations. We have also shewn that in the brain of the degraded man, there is not that full growth of

* Applying the transcendental anatomy—the unity of organism—only to the "family of man," as Dr. Knox professes to do in his last work, and the conclusion which we hold in common with Dr. Knox is, that the human family is a unit, modified into permanent varieties by a law; that law operating in combination with external circumstances, and adapting each variety of the family to those circumstances. As rational theists, we hold further, in opposition to brute atheism, that the law, and man and its subject, and the circumstances of his being, and the adaptation of one to the other, proceed from a Being All-Wise and All-Powerful—the CREATOR of all.

parts, or that well balanced proportion between the cerebral masses in the savage or criminal classes that is found to prevail in the enlightened and moral families. It is also true, that the changes which take place in the form of crania are much more rapid in case of declension of character than in the opposite case of rise and progress from barbarism to civilisation ; and this would seem to be in accordance with the laws of growth and organisation,—injury, disease, or arrest of growth may take place very suddenly in the organs of the body, or in the whole, but repair and restoration to the primitive condition is more slow and difficult. Food, climate, isolation, or free communion between races, moral or immoral influences, are the circumstances which continually interpose to affect the destiny of man ; and when his reason has become obtuse, or his moral nature blunted, he falls to the condition of brute life. Yet the singular power of adaptation which man possesses enables him to occupy every portion of the earth, gives him an advantage over most creatures, and furnishes one proof of that goodness and wisdom manifested in so wondrous a creation. If man had been originally created at different centres, there must have been some very patent reason for such an arrangement ; and we may conceive, that so very marked a diversity of origin would have been preserved, and admixture prevented by some law analagous to that which controls amalgamation between allied species in the inferior animals. No such law exists to curb the intercourse among nations; on the contrary, nations and families are constantly blending, and enlightened peoples, compelled by irresistible impulse, push themselves even into areas which are occupied; sometimes freely admixing with the occupants, at other times putting further back the aboriginal holders of the soil. If there ever were centres of creation of men, we cannot tell how many or where they were; for intermixture is so complete, that the supposed central birth-places are lost, and the object of such a method of creation rendered incomprehensible. However much, therefore, the external colour and form may vary, we see nothing but the action of the law of adaptation which, through the influence of external conditions, establishes a conformity between man and the climate which he lives in.

It is to the inner life that we look for that manifestation of unity which offers such decided proof of the oneness of the race; it is in the perfect accordance of the human mind that we discover that we are all men of like passions, liable to be influenced by the same motives, and swayed by similar feelings and incentives to good or evil. In all who do not act up to the standard of good morals, the coarse and brutal propensities of man's nature are in more or less active exercise; while in those portions of the race in which the moral law is the standard by which actions are weighed, there more or less the nobler and purer faculties of the spirit are in vigorous and healthful exercise. But the student of Natural Theology may fairly draw some very cogent reasons for the unity of man's nature, from the necessities arising out of those relationships which stimulate commercial enterprise, and set in action that ceaseless energy by which the ebb and flow of products of different climes are kept in motion. There is a mutual dependence between the respective nations of men, which forces them into communion sooner or later, and the tendency of which is to harmonise and consolidate those bonds of peace, by means of which elevation and improvement are effected. It is no mere worldly wisdom which inculcates the duty of sending to savage and heathen men a knowledge of the arts and industry of civilisation, along with that which they may subsequently admit to be "true knowledge;" it is much more reasonable, and in accordance with the dictates of religion, to prevent the mischievous idleness and apathy of heathen life, by supplying new and useful occupations, and by creating a desire for the possession and enjoyment of those appliances of educated man, which have been found most conducive to a healthy standard of social and moral life. Rarely has success waited on trials which have been made to win the heathen man—grown up in vice—to paths of virtue; and the disappointment which follows the attempt, too often blunts exertion and consigns to destruction generations of souls. Let the fact be recognised that "the child must be trained in the way he should go, that when he is old he may not depart from it:" gather the children of such heathen nations as commerce—or purer motives than those of gain—throw in the way of truth, and do the best we can to put into operation good lessons for the improvement of the grown-up man, and little disappointment will succeed so glorious a work. Commerce, as the hand-maid to religion, promises to do for Africa what, if its powerful co-operation had been more fully recognised, it would have done more successfully for India; and what, on no contemptible scale, it has done and is doing for the negroid West Indian. Anatomy has taught us that in the young of the human family there is that identity of type which proclaims the original unity of the family of man; and if in the growth and development from childhood to age, there be hindrance in the work of perfection—if we fail to cultivate the mind to the highest standard of excellence, we may be sure that the task of renovation will be a more arduous one, than that which is undertaken in behalf of the as yet undeveloped infant. Educate, therefore, the mind; improve the intellectual and moral capacity of the young; teach them; let them know that the earth which they inhabit was meant to yield its fruits and treasure to supply the wants of man; let them feel and know that man has wants which are to be satisfied—

wants which are necessary to the advancement of his highest interests; and the interpretation of the lesson which flows from such a contest with the material world will plainly declare, that in all this striving after physical and mental improvement, there is but the gross and shadowy prefiguration of that comeliness and rich perfection which shall hereafter be given to man. Herding with the beasts of the forest, and dwelling amid that primal vegetation which naturally clothes the earth, the chief lessons to be learned by the heathen are those which tell of that utter degradation which renders him dead to responsibility, and almost lost to the knowledge of good. Cursed is the ground for man's sake, and he cares not to remove the briar nor the thorn, alike emblems and portions of the curse. The vision of Paradise dawns not on his mind, and the wild wilderness of sin neither brings remorse to his heart nor yet a blush to his cheek. Is there not a deep and searching witness against us in the mute but eloquent voice of nature? Is not the triumph of agriculture over the forest-encumbered soil something like a triumph of man over the spoiling of evil, a conquest over a corruption which embitters his life? And if in this continuous conflict with the world of matter, the victory be so far complete as to all but efface the defamation which neglect or slothfulness permits, and which sin brought in: how much more real, how much more important that fiercer contest which man must wage with the mad and boisterous passions which rage against his spirit. Religion, and the arts and occupations of a moral and virtuous people, must ever be conjoined, as man's body and soul are conjoined. Moral and virtuous precepts, holy laws, holy actions, are essential to a holy life of the soul: profitable employment, commercial prosperity, and national advancement, are essential to the dignity of the temporal condition of man. Happy that people who, in these pursuits and in such prosperity, see but the types of an endless future. While the soul of man must be kept in holiness, none need suppose that the body is not to be held in high respect. The body is part of the man, and must be elevated along with the spirit; for both are required to worship Him who is the Creator. We are under the influence of a false humility to leave our bodies grovelling in the dust, and to speak as if they formed no essential part of our nature: the operations of nature tell us otherwise. He who created the body deemed it worthy to be taken into Himself, and He who took it into Himself suffered it not to see corruption. In the world of nature we see how He hath, in perfect wisdom, fashioned all material forms, and made of our flesh tabernacles, in which the spirit may dwell: as the earth, garnished and cropped with its richest fruits, tells that the husbandman's care has been diligently employed in keeping down the choking briar and destructive thorn, and so gaining a harvest of good grain: in like manner the exhibition of virtue, industry, and all morality, not only sets forth the elevation of man's inner nature, but it includes in the advancement that of his external nature also, and holds the possessor of such gifts up as an example to be imitated.

The tide of history has floated down its troubled surface a clear indication of the possession by the human family of the knowledge of "good and evil," and therefore of that knowledge which proves man to have the faculty of understanding the difference between actions which are moral and immoral; and at the present hour the whole world—as it has ever been—is arrayed in opposition and in continued conflict, by the struggle for dominion which is perpetually waged by morality against immorality. It is in the nature and progress of this uncompromising strife that the theologian looks for evidence of a supernal and controlling influence. It is a conflict, in which all will admit, that the natural man is most easily induced to lend himself to the cultivation of appetites which are earthly, and to desires which are centred on the possession and enjoyment of immediate gratification. It is a conflict against a condition which seduces the present life to be swallowed up in bodily delights and passions: a conflict in which the natural man is easily overcome, and his knowledge of good utterly overturned by his aptitude for the acquirement of the knowledge of evil. Surely if we study man as related to the creation, and contemplate the marvellous display of sympathy and powers which have been and are yet expended in the cause of human advancement, we would cease, both in the pulpit and on general occasions, to ridicule that charity which engages itself in reclaiming the vicious, or to decry his nature as something too debased to merit the care or engage the sympathy of an All-Wise Creator. The exclamation uttered of old, "What is man that Thou regardest him," was never meant to condemn to dust that creature who, alone, of all earthly beings, was capable of chaunting the praises of Him who created all things. It was the cry of humiliation, wrung from the soul of one who had tasted of the knowledge of good and evil, and had been permitted to feel, and had had strength given him to escape from the one and to hold fast to the other. It is not, however, from the moral man alone that we derive attestation of the superior value of morality over vice; it is from the corrupt and depraved themselves that we may draw testimony in support of that nobler condition which is the result of a better life. The truly unfortunate revolutionist, hurled by the whirlwind of vicious passions into scenes dark and dismal, yet had judgment enough to declare "that if God did not exist, it would behove man to invent Him;" and whether we contemplate the barbarism which deluged the streets of a civilised city with blood, or the matchless treachery by which christians were butchered by demi-civilised Asiatics, we must conclude that even earthly happiness is best and only secured by the full display of moral excellencies enjoyed by those nations which have reached the highest prosperity; for in proportion to the full developement of their moral life, has been, and is, their pre-eminence.

If it be true that, by the constitution of his present nature, the tendency of man is towards evil; by what power is he turned from that evil, which may, in the main, bring present enjoyment? It is not possible that a people should rise to the enjoyment of a dignified position who are under the influence of evil principles: yet however dwarfed and corrupt their notions of "the good" may be, should they attain a position, it is by such goodness as they possess, that they are ever raised to any degree of happiness. The history of the birth of Righteousness in apparent weakness—its conflict with principalities and powers, with the rulers of this world, and with spiritual wickedness in high places—convinces the reasonable mind that there was, and is yet, in this unequal contest between good and evil, an unseen but not unfelt power, which is quite adequate to the task of victory: a power in action which is not in its mode of acting akin to the mode of action of any thing earthly. It is to be somewhat understood by the mysterious working of that energy, which, in the body, is perpetually supplying the waste of lost parts, and which more than symbolises that property of mind which is for ever urging on to the recovery of lost perfection. As in the body, there is this perpetual contest between opposing forces; the one reaching to the attainment of good, and the other to degradation and loss. So in the race of man: there is a mighty conflict between good and evil; the former attained only by the mysterious and subtle agency of that unseen power which is felt in the life, and in the achievement of victory over evil.

While the accidents of man's life influence to a considerable degree his conformation—mental and bodily—it is no less true, that in all ages and circumstances there is a tendency to reversion to the primitive type; a desire for, and an appreciation of those better qualities of mind which characterise man in his most perfect state. A distinction between right and wrong seems innate, although the judgment may be dubious as to what in every case constitutes right and wrong. Rewards and punishment are dispensed by the most savage nations; and, in many of them, admiration for the loftier attributes of man's nature is carried to a superstitious extent. The religious fanaticism of the Hindoo and the Chinese, stimulated both by a subtle philosophy and sensualistic faith, teaches us how intensely the mind may be nerved to vigorous action, through the avenue of the senses and emotional qualities; and accounts for the fact that the form of christianity which influences, in the first instance, the masses most, is that which appeals to their emotions. Under the most adverse circumstances christianity has retained its place amongst the Asiatics in that form which prevails in the Eastern Church, through a rich ceremonial and rites which appeal to the senses and emotions. In elevating to a moral and religious life the lapsed and degenerate heathen, we ought surely to reach his mind through those channels which yet remain most accessible—to appeal to his reason primarily is not enough, his senses and emotions must be employed to stimulate and develope the loftier reason. Mahomet supplanted a pure faith by thus employing and energising the lower faculties of the spirit of men: may we not supplant his sensual creed, by engaging those very powers, and so lead the reason to exercise itself upon holier and more rational truths? The deep and eternal truths of religion may be set visibly forth by the symbols of a pure christianity and the harmony of musical service, together with a rational and meaning ceremonial, acting on the senses and emotions, may, through the understanding, supplant idolatrous rites; while the higher and holy duties of practical religion may, by appealing both to the emotions and senses, enlighten the reason and win the creature from his corruptions. The emotions and senses are not in themselves bad, since they are implanted in us by the Creator; it is the mis-use and mis-direction of them that lead captive and enslave the whole being. Neglecting the cultivation of the three great avenues to the spirit, christianity itself has been made a stone of stumbling and a rock of offence; but a wise and well-balanced system continues, now as ever, to keep truth in the world, and towards it, sooner or later, all will gravitate. When emotion and sensualism stand in the place of a reasonable faith, then do we see debasement and corruption ensue, and that fanaticism which incites to massacre follow; it matters not whether the actors be professedly christian or mahomedan, or the Indian or African fanatic, the result is the same. We thus perceive that the constitution of the human mind is similar in the most widely separated members of the family of man; and in order to raise him to the highest perfection, the whole creature must exercise and rightly use those powers and properties with which he has been gifted. Living with his body and soul directed towards his destined end, man becomes an object worthy of contemplation; and in his aspirations and strivings after that perfection which was manifested in "the flesh which was taken into the Beauty of Holiness"—and after which even the heathen sought—we learn to elevate the human race high above all earthly beings, and to understand somewhat the dignity with which it is clothed, when graced with the appellation, "Sons of God." As the result of the examination into the plan of creation, and as unfolded to us by the nature of the works themselves, we cannot resist the conviction that we are the occupants and the objects of a grand and imposing world, whose aim is the glory and worship of a Being whose goodness is over all His works, and by whom alone they are and were created.

In the visible works of creation is clearly seen the Invisible Worker, and in the operations of His might he is revealed to us as he has discovered Himself to us in Scripture. He is not revealed to us as a God, fashioned after man's judgment, nor is His Being to be understood after the similitude of men. He is made known to us as the Infinite God, but Infinite in Holiness, Goodness, Mercy, Truth, Perfection, Energy. He is Absolute, as including every thing that excludes evil, and yet having power over evil to subdue and root it out. We may not create a God after our own image, nor fashion Him by our own language. We must accept Him as He is to us, as He is in relation to all things, even to Himself. Thus there is no limit to our religious thoughts—our conception, of that All-Wise, All-Holy God, infinite in mercy, goodness, and truth; the Almighty, the Everlasting, the Being who declared Himself "I AM." We may not limit

Him by our thoughts ; we may not create Him an image fashioned by our modes of speech. We dare not, like those of old, make a God and worship it. We can worship Him who has made Himself known to us as the Creator, Sanctifier, and Saviour of His people. We can give the Lord the honour due unto His name, and worship Him with holy worship.

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CHAPTER II. *continued.*

CHAPTER II. *continued.*

BOOK II.

Chapter II. *continued.*

BOOK III.

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