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ARTICLE I.

DOMESTIC LITERATURE.

Tallulah and other Poems. By HENRY R. JACKSON. *Savannah, Ga. Jno. M. Cooper, Publisher*, 1850.

POETRY is both the beginning and the climax of a nation's literature. It not only reduces the jargon of a half-formed language to harmony, but, when thus harmonized, adduces from it its highest and most perfect combinations. As the same spirit of God that arranged and beautified the primal chaos—separated also, from its unintelligent order, its last and highest work, man—so the genius of the poet not only combines, into a harmonious language, the rude accents of a semi-barbarous people, but exalts, so to speak, upon that language, when formed, its noblest and highest monument—the drama, or the epic.

The historical facts that prove this proposition are curious and interesting. The oldest literature in the world is the Jewish. Of that literature, Moses was (instrumentally) the father. But Moses was not only a poet, but the very prince of poets. The Song of Miriam at the Red Sea, and his Farewell to Israel on the plains of Moab, have never been surpassed. But he is the author, either by origin or translation, of the book of Job. The style, age, general character, and especially its incorporation into the Holy Scriptures, all indicate Moses as its author,

the Bible; on the contrary, we are convinced that they have done important service to the cause of Theology, both natural and revealed; and furnished to each some of its most conclusive arguments and sublimest illustrations.

[NOTE.—We shall return to the subject in a following number.]

ARTICLE VI.

Foot-Prints of the Creator, or the Asterolepis of Stromness. By HUGH MILLER, *author of the Old Red Sandstone, &c. 1 vol. 8vo. pp.* 337.

In our last number we gave a brief notice of this volume. We propose now, by examining it more critically, to show that it merits a deliberate perusal by all classes of readers, Christians especially.

The author is certainly one of the most remarkable men of the age. He is a living illustration of the truth, that some men, despite the most untoward circumstances of birth and fortune, are destined to accomplish some high civil, moral, or religious purpose. About the time of his birth, infidels triumphed in the hope of soon discrediting the Bible, by discoveries in physical science, especially geology, then in its period of bold, reckless youth, with the amiable, learned, and eloquent, though infidel Scotch professor, Playfair, among its most zealous cultivators. Like our own Franklin, Mr. Miller has raised himself from the toils of a laborious and humble profession, by great industry, superior genius, pure morality, and active piety, to a commanding and useful position in the social scale.

Physical science should not be content with advancing civilization, by multiplying the comforts of life, increasing the refinement of human feeling, adding facilities for the general enjoyment of high intelligence, and diminishing the miseries of superstition. It should aspire to do much more;—not merely to raise man's thoughts from nature up to nature's God, by educing proofs of divine wisdom, de-

sign, and benevolence from each of the endlessly varied objects of the material world, but to persuade man to believe God's word, by demonstrating the reality of a beautiful harmony between scientific and revealed truth. "Remembering that the revelations of natural science cannot, in any way, injure the revelation of eternal truth, but, on the contrary, aid to establish, in the minds of the doubting, a firm conviction of its divine origin, and of man's high position, we need never fear that we are proceeding too far with any inquiry, so long as we are cautious to examine the conditions of our own minds, that they may not be made the dupe of our senses."* We shall show, in the sequel, that, in this spirit, Mr. Miller studied science;—that to this noble use he has applied his varied attainments;—that while ascertaining, by patient observation and abstruse processes of reasoning and generalization, the exact position, character, and function of a scale, a tooth, or a skull of an extinct fish, (the Asterolepis,) he was preparing to employ his knowledge in refutation of infidel error, believing "that of all men, the geologist stands most in need of the Bible."

That the reader may the more readily appreciate the merits of this work, we think it advisable to preface our examination of it with a brief sketch of the author's life, and with an enumeration of his other literary and scientific labors. We begin with an extract from Sir D. Brewster's full and very interesting memoir:

"Mr. Miller was born at Cromarty, of humble but respectable parents, whose history would have possessed no inconsiderable interest, even if it had not derived one of a higher kind from the genius and fortunes of their child. By the paternal side he was descended from a race of sea-faring people, whose family burying-ground, if we judge from the past, seems to be the sea. Under its green waves his father sleeps; his grandfather, his two grand-uncles, one of whom sailed round the world with Anson, lie also there; and the same extensive cemetery contains the relics of several of his more distant relatives. His father was but an infant of scarcely a year old at the death of our author's grandfather, and had to commence life as a poor ship-boy; but such was the energy of his mind, that, when little turned of thirty, he had become master and owner of a fine, large sloop, and had

* Hunt's Poetry of Science, p. 309.

built himself a good house, which entitled his son to the franchise on the passing of the Reform Bill. Having unfortunately lost his sloop in a storm, he had to begin the world anew, and he soon became master and owner of another, and would have thriven, had he lived; but the hereditary fate was too strong for him, and when our author was a little boy of five summers, his father's fine new sloop foundered at sea, in a terrible tempest, and he and his crew were never more heard of.

Mr. Miller had two sisters younger than himself, both of whom died ere they attained to womanhood.

His mother experienced the usual difficulties which a widow has to encounter in the decent education of her family; but she struggled honestly and successfully, and ultimately found her reward in the character and fame of her son. It is from this excellent woman that Mr. Miller has inherited those sentiments and feelings which have given energy to his talents as the defender of revealed truth, and the champion of the Church of his fathers. She was the great grand-daughter of a venerable man, still well known to tradition in the north of Scotland as Donald Roy of Nigg—a sort of northern Peden, who is described in the history of our church as the single individual who, at the age of eighty, when the presbytery of the district had assembled in the empty church for the purpose of inducting an obnoxious presentee, had the courage to protest against the intrusion, and to declare 'that the blood of the people of Nigg would be required at their hands, if they settled a man to the walls of that church.' Tradition has represented him as a seer of visions and a prophesier of prophecies; but whatever credit may be given to stories of this kind, which have been told also of Knox, Welsh and Rutherford, this ancient champion of Non-Intrusion was a man of genuine piety, and the savor of his ennobling beliefs and his strict morals have survived in his family for generations. If the child of such parents did not receive the best education which his native town could afford, it was not their fault, nor that of his teacher. The fetters of a gymnasium are not easily worn by the adventurous youth, who has sought and found his pleasures among the hills and on the waters. They chafe the young and active limb, that has grown vigorous under the blue sky, and never known repose but at midnight. The young philosopher of Cromarty was a member of this restless community; and he had been the hero of adventures and accidents among rocks and woods which are still remembered in his native town. The parish school was, therefore, not the scene of his enjoyments; and while he was a truant, and, with reverence be it spoken, a dunce,

while under its jurisdiction, he was busy in the fields and on the sea-shore, collecting those stores of knowledge, which he was born to dispense among his fellow men. He escaped, however, from school, with the knowledge of reading, writing, and a little arithmetic, and with the credit of uniting a great memory with a little scholarship. Unlike his illustrious predecessor, Cuvier, he had studied Natural History in the fields and among the mountains, ere he had sought for it in books; while the French philosopher had become a learned naturalist before he had even looked upon the world of Nature. This singular contrast it is not difficult to explain. With a sickly constitution and a delicate frame, the youthful Cuvier wanted that physical activity which the observation of Nature demands. Our Scottish geologist, on the contrary, in vigorous health, and with an iron frame, rushed to the rocks and the sea-shore in search of the instruction, which was not provided for him at school, and which he could find no books to supply."

In 1821, he set out, as he informs us, "a slim, loose-jointed boy," to engage in an occupation, that of a stone-mason, "in which men toil every day, that they may be enabled to eat, and eat every day, that they may be enabled to toil." In the first chapter of the "Old Red Sandstone," the reader will find brief and beautiful descriptions of the scenes in which his labors began, and of the objects that arrested his attention. On slabs of sandstone he found, after the novel and exciting process of blasting with gunpowder had split the rock asunder, abundant evidence of ancient ripple-marks,—"the resemblance was no half resemblance—it was perfect,"—and wondered what had become of the waves that left their impress on the solid rock. In superincumbent beds of diluvial clay he observed stones, different both from the sandstone below and from one another, all rounded and water-worn, "as if they had been tossed in the sea for hundreds of years." In one noble section, "a sort of chance dissection in the earth's crust," ne perceived veins of granite, dizzy precipices of gneiss, and huge, irregular masses of hornblende, in one part; the "little known, but highly interesting" fossils of the Old Red Sandstone, in another part; and the beautifully preserved shells and lignites of the Lias, in another. He laid open with his hammer nodular masses of bluish Lias limestone; and, "wonderful to relate," found in one a beautiful finished sculpture, (an ammonite,) "like one of the flu-

ted volutes of an Ionic capital;" in another, scales of fish; and, in another, a piece of decayed wood. Of all nature's riddles, these seemed to him, then, most difficult to expound; but being naturally a philosophical inquirer and close observer, he "treasured them carefully up,"—thus early manifesting the highest attribute of genius—minute attention to every thing presented to the senses.

His curiosity having been thus thoroughly aroused, in his first few days of labor, he was informed by a companion, to whom he exhibited his collection of curious things, that, at the distance of two miles, were curiously-shaped stones, called *thunderbolts*, and like the heads of boarding-pikes, which, in the days of his father, people regarded as remedies for "bewitched cattle." Taking advantage of an afternoon holiday, (which most young men would have wasted in idleness or vice,) he visited the designated spot, and found in it a richer scene of wonders than he could have "fancied even in his dreams."

His attention was soon arrested by a group of rocks, wholly different in color and organic contents from both the primary granites and the sandstone cliffs, and consisting of thin strata of limestone, with thick beds of bituminous shale. "The layers into which the beds readily separate are hardly an eighth of an inch thick, and yet on every layer there are tens of thousands of the various fossils peculiar to the Lias. We may turn over these wonderful leaves, one after another, like leaves of a herbarium, and find the pictorial records of a former creation in every page. Scallops and gryphites, ammonites of almost every variety peculiar to the formation, and eight or ten varieties of belemnite; twigs of wood, leaves of plants, cones of an extinct species of pine; bits of charcoal and scales of fishes; and, as if to render their pictorial representation more striking, though the leaves of this interesting rocky volume are of a deep black, most of the impressions are of a chalky whiteness. I was lost in admiration and astonishment. .... I passed from ledge to ledge, like the traveller in the tale, through the city of statues, and at length found one of the supposed thunderbolts. .... I learned, in time, to call this stone a belemnite, and became acquainted with enough of its history to know that it once formed a part of a variety of cuttle-fish, long since extinct."

"In short, the young geologist, had he all Europe before him, could hardly choose for himself a better field.

I had, however, no one to tell me so at the time, for geology had not yet traveled so far north; and so, without guide or vocabulary, I had to grope my way as I best might, and find out all its wonders for myself. But so slow was the process, and so much was I a seeker in the dark, that the facts contained in these few sentences were the patient gatherings of years."

We close this account of our author's early toils and studies in the words of Sir D. Brewster:

"After having spent nearly fifteen years in the profession of a stone mason, Mr. Miller was promoted to a position more suited to his genius. When a bank was established in his native town of Cromarty, he received the appointment of accountant, and he was thus employed for five years in keeping ledgers and discounting bills. When the contest in the Church of Scotland had come to a close, by the decision of the House of Lords in the Auchterarder Case, Mr. Miller's celebrated letter to Lord Brougham attracted the particular attention of the party which was about to leave the Establishment, and he was selected as the most competent person to conduct the Witness newspaper, the principal metropolitan organ of the Free Church. The great success which this journal has met with is owing, doubtless, to the fine articles, political, ecclesiastical, and geological, which Mr. Miller has written for it. In the few leisure hours which so engrossing an occupation has allowed him to enjoy, he has devoted himself to the ardent prosecution of scientific inquiries."

The reader must not infer, from what has been said, that Hugh Miller's studies were confined exclusively to geology. Far from it. His writings all attest that as he was, in his boyhood, "a reader of curious books, when he could get them—a gleaner of traditionary stories," so his exuberant fancy and ardent thirst for knowledge did not permit him, in toilsome manhood, to neglect to store well his mind with rich treasures of poetic, historical, and even legal lore. The frequency, skill, and taste, with which he enriches his most profoundly learned pages, with apt illustrations from history, poetry, art and science, evince the avidity with which he sought knowledge from all the high and pure sources of it, and also the retentiveness and readiness of his memory.

Hence, he has shown himself competent to the discussion of a variety of unconnected subjects. In the "Traditional

History of Cromarty" he displayed a familiar acquaintance with Scottish scenery, history, and legends. In his "Letter from one of the Scotch people to Lord Brougham, on the opinions expressed in the Auchterarder Case," he showed an intimate knowledge of the history, tenets, and legal rights of the Church of Scotland. His "Whiggism of the Old School, as exemplified in the past History and present Position of the Church of Scotland," is a work of much historical and theological merit. And his "First Impressions of England and its People," published in '47, "is full of knowledge and of anecdote, and is written in that attractive style which commands the attention even of the most incurious reader." "This delightful work, though only in one volume, is equal to three of the ordinary type, and cannot fail to be perused with high gratification by all classes of readers. It treats of every subject which is presented to the notice of an accomplished traveller, while he visits the great cities and romantic localities of merry England. We know of no tour in England, written by a native, in which so much pleasant reading and substantial instruction are combined; though we are occasionally stopped, in a very delightful locality, by a precipice of the Old Red Sandstone, or frightened by a disinterred skeleton, or sobered by the burial service over Paleozoic graves, we soon recover our equanimity, and again enter on the sunny path to which our author never fails to restore us."*

In this long digression from the work before us, we have had in view a definite purpose. Our object has been, not so much to write a biography of the author, as to convince the reader, that Mr. Miller's calm temperament, superior intellect, aptitude for correct observation, habits of patient investigation, high attainments in general science, refined taste, experience in controversial writing, profound knowledge of geology, and sincere belief, from early education and mature reflection, in the Calvinistic interpretation of Revelation;—that this extraordinary combination of qualities fitted him, if any man can be qualified, to view calmly and understand fully the connection between science and the Bible. Having labored, as mason and geologist, ham-

*Sir D. Brewster's Memoir.

mer in hand, nearly twenty years, in numerous quarries, in different geological formations, in a country in which the geological series of rocks, from the oldest to the most recent, is nearly complete and magnificently developed, he cannot surely be charged with ignorance or prejudice, nor regarded as liable to the errors of a closet geologist. What he describes, he has seen, and often disentombed. Hence, Agassiz says, justly, "his generalizations have nothing of the vagueness which too often characterizes the writings of those authors, who have attempted to make the results of science subservient to the cause of religion." And far from believing all that is promulgated as scientific truth, our author cautions his readers against the scientific credulity of this age. "There is," he says, truly, "a species of superstition, which inclines men to take on trust whatever assumes the name of science, and which seems to be a reaction on the old superstition, that had faith in witches, but none in Sir Isaac Newton, and believed in ghosts, but failed to credit the Gregorian Calendar." Indeed, his inquisitive, astute mind, long strictly trained in the severe school of induction, is neither bewildered by words nor convinced by merely specious arguments. Thoroughly imbued with the true spirit of the Baconian philosophy, he coolly collects and cautiously collates facts, from which conclusions necessarily follow, to be employed in future generalizations. Hence, he yields assent to none of the scientific humbugs of the day, from the juggles of mesmerism and the buffoonery of phrenology, to those more subtle, more dangerous doctrines, which threaten "to strike down all the old landmarks, ethical and religious."

The volume before us is the last published work of the author. It had passed rapidly through three London editions, when it was republished, last year, by Gould & Co., Boston, with a memoir by Sir D. Brewster, and critical notes by Agassiz.

Its first title, "Foot-Prints of the Creator," was suggested by Dr. Hetherington, the well-known historian of the Church of Scotland. For several reasons, we regard this title as an unfortunate one. Besides the questionable propriety of investing Deity, in any human production, with such organs as feet, it savors of imitating such titles as "Medals of Creation," "Vestiges of Creation," &c.; es-

pecially as the "Asterolepis of Stromness" indicates both the leading object of the scientific portion of the work, and the highly important use made of that extinct ichthyic monster in demolishing one hypothesis, and in establishing another on its ruins.

Were we disposed, we could easily institute a few verbal criticisms; for we find, in the "Asterolepis of Stromness," words and phrases quite as objectionable as "in our midst," "reliable," "in this connection," "doctor" for physician, so learnedly animadverted on as defects in "Everett's Orations and Speeches," in seven compact pages of a recent review of that collection. Our object, at present, is not, however, the exercise of critical acumen, of which we profess to have very little; yet we must assure the reader that Mr. Miller possesses, in as great a degree as any living writer, the combination of those qualities of style,—"clear, vivid and powerful, ranging at will, and without effort, from the most natural and graceful simplicity, through the playful, the graphic, and the vigorous, to the impressive eloquence of great thoughts, greatly expressed,"—which enables him to make the most abstruse scientific descriptions and discussions both intelligible and interesting to the general, even unscientific reader.

In the composition of the work, the author had mainly in view a threefold design: 1st, the publication of new, important and interesting scientific discoveries, chiefly in the ichthyic branch of palæontology, and made by himself in one of the oldest systems of the fossiliferous rocks, the Old Red Sandstone; 2d, the refutation of the development hypothesis of DeMaillet, Lamarck, Oken, and the "Vestiges of Creation;" and, 3d, the exposition of a new and strangely interesting theory, the *Progress of Degradation.*

What is the development hypothesis? We will let Oken and Lamarck answer the question.

"There are," says Oken, "two kinds of generation in the world: the creation proper and the propagation that is consequent thereon, or the *generatio originaria* and *secundaria.* Consequently, no organism has been created of larger size than an infusorial point. No organism is, nor ever has one been created, which is not microscopic. Whatever is larger has not been created, but developed; man has not been created, but developed." Lamarck held

"that inert matter was endowed with life; until, in the course of ages, sensation was superadded to mere vitality. Sight, hearing and the other senses were afterwards acquired; then instinct and the mental faculties; until, finally, by virtue of the tendency of things to *progressive improvement*, the irrational was developed into the rational."

But, it was asked, if the process of *development by law* has been in progress, during the long periods of time which geology proves to have elapsed since creation began, —that indefinitely remote period denoted by the words, "In the beginning,"—why are there still such multitudes of distinct species of conferva, algæ, infusoria and corals? Why has this been the case in all geological eras? Why have not all been developed into trees and animals high in organization?

In answer to this objection, Lamarck replied, by another hypothesis, "that nature is not an intelligence, nor the Deity, but a delegated power, a mere instrument, a piece of mechanism acting by necessity, an order of things constituted by the Supreme Being, and subject to laws which are the expressions of his will. This nature is obliged to proceed gradually in all her operations. She cannot produce animals and plants of all classes at once, but must always begin by the formation of the most simple kinds, and, out of them, elaborate the more compound, adding to them, successively, different systems of organs, and multiplying, more and more, their number and energy." "She is always beginning anew, day by day, the work of creation, by forming monads, or 'rough draughts,' (ebauches,) which are the only living things she gives birth to *directly*."* And Oken is more explicit. He says, "Plants and animals can only be metamorphoses of infusoria. This being granted, so also must all organizations *consist* of infusoria, and, during their destruction, dissolve into the same. Every plant, every animal, is converted by maceration into a mucus mass: this putrefies, and the moisture is stocked with infusoria. Death is no annihilation, but only a change. One individual merges out of another. Death is only a transition to another life—not into death. This

* Lyell's Prin. of Geol. 1 vol. 8vo. p. 552.

transition from one life to another takes place through the primary condition of the organic or the mucus."

True, Lamarck admits the creation, at first, of primary rudiments of plants and animals, and, probably, of the great divisions of each. A profound philosopher, and learned naturalist, he perceived that the uncontrolled exertion of the *tendency to progressive development* ought, during the long periods of geologic time, to have left, registered in the rocks, clear proofs, (and this nearly all geologists denied,) of a gradual transition from the simplest to the most complex structures,—from a mere rudiment of an organ in one age, to its full development in another,—from the humblest to the most exalted intelligence. To explain why such a complete, unbroken chain of evidence is not found in the rocks, he ascribed great influence to another principle, the modifying *agency of external circumstances*, —climate, food, the relations of animals to plants as each spread from different localities—the fluctuating nature of localities, now sinking below the sea, now rising above its level.

Some of our readers may think such an hypothesis too absurd to demand a refutation. If so, they forget the proneness of man to believe any form of infidelity, and underestimate the ingenuity, talent and learning arrayed in its defence by many writers, and especially by Lamarck in his Philosophic Zoology, and the Introduction to his great work on the invertebrate animals; by the German professor, Oken, in his "Phisio-Philosophy;" and by the author of the "Vestiges of Creation" and the "Sequel." These authors sought their arguments from astronomy, botany, zoology and geology. They ingeniously distorted the nebular hypothesis of Herschell, that nebulæ may pass into comets, comets into incandescent suns, and these, by radiation, into habitable worlds like our earth. They appealed to the changes effected in plants and animals by cultivation and domestication. Above all, they dwelt with delight and confidence on the supposed evidence furnished by geology of progress from less complex and less perfect tribes of animals and plants, in the first fossiliferous period, to more and more perfect and complex forms, in each succeeding period, till man appeared an improved ourang-outang.

The telescope of Lord Rosse drove them from the astronomical argument, by resolving most of the nebulæ into fixed stars inconceivably remote and numerous. Botanists and zoologists, finding no evidence, (except in a few doubtful cases of hybridity in plants and the lower animals, which can be most satisfactorily explained on other principles,) of transmutation of one species into another, though they had examined more than 100,000 species of existing plants, 120,000 insects, 10,000 mollusca, 8,000 fishes, 8,000 birds, 1,300 mammalia, and many thousands of other animals, amounting, altogether, to near two millions of living species,* decided "that species have a real existence in nature, and that each was endowed, at the time of its creation, with the attributes and organization by which it is now distinguished."†

We admit, said these theorists, the apparent stability of species, if we limit our investigations to the narrow period of the human era; but "there has been," says St. Hilaire, "an uninterrupted succession in the animal kingdom, effected by means of generation, from the earliest ages of the world up to the present day, and the ancient animals, whose remains have been preserved in the strata, however different, may, nevertheless, have been the ancestors of those now in being."

This perversion of geology by naturalists, who were ignorant of that noble science, naturally enough caused it to be regarded, for a time, as hostile to revelation. Hence, too, many theological writers, though aware that the first chapter of Genesis can be literally so interpreted as to admit the high antiquity of the earth, not as the habitation of man, but as a planet of the solar system; and that the weight of theological evidence was in favor of this interpretation, before geological phenomena were known, adopted the opposite interpretation, and clung long, but vainly, to the opinion, that "the heavens and the earth," the sun and moon, and "the stars also," were created out of nothing, when man, with existing plants and animals, was brought into being, only about six thousand years ago.

The geologists were thus placed between hostile parties, the advocates of the development hypothesis, on one side,

* Am. Jour. Sci., vol. 1, second series, p. 132.
† Lyell's Prin. Geology, 1 vol. 8vo. p. 589.

and mistaken, but learned and pious, defenders of the Scriptures, on the other. They were exposed to the assaults of both. Had they abandoned their investigations, who can estimate the injury that would have been done, both to science and the inspired volume? Fortunately, the leading English geologists, Murchison, Sedgwick, Buckland, Smith and Harris, were also learned, and, we believe, pious divines; and sustained by an ardent love of truth, physical and revealed, and believing that no real discrepancy between them can ever be proved, they fearlessly prosecuted their investigations, collected an immense mass of facts, and studied carefully the 20,000 species of fossil plants and animals, that had been ascertained and described. Applying to these the rules employed by botanists and zoologists, and even adopting the "laws of evidence, promulgated by Hume in his argument on miracles, and La Place in his doctrine of probabilities," they proved that the plan of creation has been the same, in all past periods; that it has been gradually unfolded and expanded, in successive distinct periods of creation; that, in all those periods, "species have had a real existence in nature;" and that the longer those periods can be proved to have been, the more fatal is palæontological evidence to the Lamarckian hypothesis, "as a mere feverish dream, incoherent in its parts, and baseless in its fabric." "Give, we ask, but one well-attested instance of transmutation, from the algæ to even the lower forms of terrestrial vegetation common on our sea-coasts, and we will keep the question open in expectation of more." It will not do to tell us, as Cuvier was told, when he appealed to the fact determined by the mummy birds and reptiles of Egypt, of the fixity of species in all, even the slightest particulars, for at least three thousand years,—"that immensely extended periods of time are necessary to effect specific changes, and that human observation has not been spread over a period sufficiently ample to furnish the required data regarding them." Can you have longer periods than those, whose history we read in geology? "The apology is simply a confession that, in these ages of severe inductive philosophy, you have been dreaming your dream, cut off, as if by the state of sleep, from all the tangibilities of the real waking-day

world, and that you have not a vestige of testimony with which to support your ingenious vagaries."

Driven, thus, from the domains of astronomy, botany and zoology, and from the thoroughly studied, more recent portions of the fossiliferous strata, the Lamarckians retreated to those oldest and deepest deposits, the Old Red Sandstone system, and the Upper and Lower Silurian systems, in which the first traces of organic life are found, all below being granite, gneiss, and other non-fossiliferous, crystalline rocks. These, they contended, especially those near the bottom, contained nothing but sea-weeds, zoophytes, brachiopods, trilobites, and a few little fishes, some of them even microscopic; and these they honored as the progenitors, by development and transmutation, of all endogenous and exogenous plants, and of all animals, whether *radiate*, *articulate*, *molluscous* or *vertebrate*.

Here, among "the ambiguities of the Paleozoic formations," says Sir D. Brewster, "the hypothesis might have lingered with the appearance of life; but Mr. Miller has, with an ingenuity and patience worthy of a better subject, stripped it even of its semblance of truth, and restored to the Creator, as governor of the universe, that power and those functions which he was supposed to have resigned at its birth."

Before we proceed to show, by giving a very brief outline of his remarkable discoveries, skilful anatomical processes of reasoning, and clear, comprehensive conclusions and generalizations, how Mr. Miller drove this hypothesis from even the deep recesses of the earth,—hitting other questionable theories of even Owen and Agassiz staggering blows as he passed them by the way,—we must inform the reader of the light in which he viewed its consequences. Having shown it to be incompatible with a belief in the immortality of the soul, and of man's accountability to God as the final judge,—practical Atheism,—though consistent with a belief in the existence of a God,—he says:

"Nor does the purely Christian objection to the development hypothesis seem less, but even more insuperable than that derived from the province of natural theology. The belief which is, perhaps, of all others, most fundamentally essential to the revealed scheme of salvation, is the belief that 'God created man upright,' and that man, instead of proceeding onward and upward,

from this high and fair beginning, to a yet higher and fairer standing in the scale of creation, sank, and became morally degraded. And hence the necessity for that second dispensation of recovery and restoration, which forms the entire burden of God's revealed message to man. If, according to the development theory, the progress of 'the first Adam' was an upward progress, the existence of the 'second Adam' is simply a meaningless anomaly."

Let us imagine Mr. Miller, a profound geologist, who had labored and studied nearly twenty years, in the Paleozoic formations, (the last retreat of the active, struggling Lamarckians,) and who had examined more of their organisms than any living savan, Agassiz and Murchison not excepted, meditating on the consequences "of a form of error, at once exceedingly plausible and consummately dangerous, and which is telling so widely on society, both in Europe and America, that one can scarce travel by railway or in a steamboat, or encounter a group of intelligent mechanics, without finding decided traces of its ravages."

He thus soliliquises,—"What, in order to establish its truth, or even to render it in some degree probable, ought to be the geological evidence regarding it? The reply seems obvious. In the first place, the earlier fossils ought to be very *small* in size; in the second, very low in organization. In cutting into the stony womb of nature, in order to determine what it contained, mayhap millions of ages ago, we must expect, if the development theory be true, to look upon mere embryos and fœtuses. And, if we find, instead, the full grown and the mature, then must we hold that the testimony of geology is not only not in accordance with the theory, but in positive opposition to it. Such, palpably, is the principle on which, in this matter, we ought to decide. What are the facts?"

To find what the facts are, he undertook an exploratory ramble into the Orkney Islands, and remained some time in the vicinity of Stromness. This busy sea-port town is situated on the island of Pomona, "a special centre," whence the Old Red Sandstone (Devonian) system may be most accurately studied. The system is a marine deposit, 10,000 feet thick, and divisible into three distinct

formations. The axis of the principle island of the Orkney group, Pomona, is a long granitic ridge. On this granite rests the highly-inclined conglomeritic base of the oldest of the three formations of the system. This conglomerate is made up, chiefly, of fragments of the basal granite, a rock which all geologists recognize as the type of the rocks that formed the crust of the infant globe, long anterior to vegetable and animal creations; for, on all hypotheses,—none, not even the Lamarckians, contending that there was no "beginning,"—there must have been a period when a marine, fossiliferous deposit commenced. This granite must have been one of the surface rocks, much exposed to disintegrating influences, near a vast, primary oceanic basin—a palæozoic Hudson's or Baffin's Bay,—into which the older conglomerate was "swept by numerous streams, rapid and headlong, and charged with the broken debris of the inhospitable regions which they drained." These, then, are the actual base of the fossilliferous rocks of that part of the globe. They were formed at the very bottom of the palæozoic sea of what is now Scotland. Other oceans, in which were formed the Silurian strata, had previously existed, in other regions, but not in that. We shall visit their beds anon, with our author, to see what was the character of their inhabitants.

Let us now confine our attention to the first deposit in this palaeozoic ocean, in which, if anywhere, we might expect to find evidence of the existence of points of vitality —our monad progenitors, according to the Lamarckian hypthesis, having begun their career of development. And what, asks the reader, did Mr. Miller find there? He tells us there are, in the lowest of the three Old Red Sandstone formations alone, "more remains of fish than in every other geologic system in England, Scotland and Wales, from the coal measures to the chalk inclusive. Orkney is, to the geologist, emphatically, the land of fish." Were the fishes small in size, "mere minnows and sprats," near the bottom? He says:—

"I traced the formation upwards along the edges of the upturned strata, from where the great conglomerate leans against the granite, till where it merges into the ichthyolitic flagstones; and then pursued these, from older and lower, to newer and higher layers, desirous of ascertaining at what distance over the base of the system its more ancient organisms first appear, and

what their character and kind. And, embedded in a grayish-colored layer of hard flag, somewhat less than a hundred yards over the granite, and about a hundred and sixty feet over the upper stratum of the conglomerate, (which is non-fossiliferous,) I found what I sought—a well marked bone—in all probability the oldest vertebrate remain yet discovered in Orkney."

A figure of this remarkable bone, in shape resembling a large roofing-nail, is given in the first chapter of the Foot-Prints. It was ascertained to be the hyoid plate bone of a fish. The length of the entire specimen was, in this instance, though the corresponding bone in ordinary fishes is, of course, small, "five seven-eighth inches, the transverse breadth of the head two inches and a quarter, and the thickness of the stem three-tenths of an inch." Judging from the place in which it was found, it must have been the remain of one of the first fishes of this ancient sea; and, as placoid, not *ganoid* fishes are characteristic of the Silurian strata, which lie, geologically, below the Old Red Sandstone, it was important to determine the order of fishes to which it belonged.

It is necessary to remind the reader that fishes, the lowest class of animals with bones, (*vertebrata*,) are arranged by Agassiz in four orders, on characters derived chiefly from the scales. 1. Placoids, as the shark, saw-fish and ray, that have fixed gills, an internal *cartilaginous* skeleton, and a dermal covering of curious scales, which are points, plates or spines of enamelled bone, (called shagreen,) "not planted on the skin, but elevated over it on an osseous stem, or foot-stalk, as a mushroom is elevated over the sward on its stem," and, of course, these scales do not overlap. 2. Ganoids, as the sturgeon, that have free gills protected by gill-covers, a cartilaginous skeleton, and angular, shining, enamelled, osseous scales, often very large, planted on the body, and sometimes arranged side by side, sometimes overlapping slightly, and sometimes each overlapping at least two-thirds of the one next below it, forming a slate-roof-like bony envelope of the skinless animal from snout to tail. 3. Ctenoids, as the perch, those having a bony skeleton, and jagged, horny scales. 4. Cycloids, as the herring, those having bones within, and covered with overlapping, circular, smooth, horny scales.

So far as is yet known, all the Silurian fishes were Placoids. The Ganoids made their appearance in the Old Red Sandstone period, during the whole of which, "the age of fishes," and all the other long periods anterior to the chalk, these two orders were the sole representatives of their class. They then retrograded, but did not wholly disappear. Their reign ended, and ctenoids and cycloids swarmed in oceans' depths.

We now return to the curious bone found by the author. Fragments of similar bones had been found in the same formation in Russia, and examined by several naturalists, and, finally, by Agassiz, who made shrewd conjectures concerning its structure and the family to which it belonged, but, even to him, "the dermal bones were mere fragments of a puzzle, the key of which seemed lost." Fortunately, in addition to the hyoid bone found by Mr. Miller near Stromness, and which fixed conclusively the exact geological position of the animal,—the remote time when it certainly had begun to exist,—he was supplied with a rich collection of bones of the same species, Asterolepis, from another locality, Thurso, by Mr. Robert Dick, a tradesman and amateur geologist, "one of those working men of Scotland, of active curiosity and well-developed intellect, who give character and standing to the rest."

Our limits do not permit us to detail the comparisons of the scales of allied families of fishes, recent and extinct, in the latter part of the third chapter of the work, in order to determine the true character of the asterolepis. Having ascertained it to be a Ganoid fish, he traced it to the Coelacanth (*hollow spine*) family,—"all squat, robust, strongly-built,"—"remarkable for the strength and weight of their bony armor," from which "a bullet would rebound flattened,"—"the head covered by strong, bony plates, roughened by tubercles,"—and "the jaws thickly set with an outer range of *true* fish teeth, and more thinly with an inner range of what seem *reptile teeth*, that stood up, tall and bulky, behind the others, like officers on horseback, seen over the heads of their foot-soldiers, in front;" "and the double fins must have borne, externally, somewhat the form of the sweeping paddles of the ichthyosauria," (a huge, voracious reptilian,) "genus." "And such was that ancient Coelacanth family, of which the oldest of our

Scotch ganoids, the Asterolepis of Stromness, formed one of the number, and which, for untold ages, has had no living representative."

Could this family of Coelacanths be the developed descendants of the placoids of the more ancient silurian seas? To ascertain the probability of this, let us fix our attention for a moment on the scales. We can imagine the foot-stalks and points of the placoid shagreen becoming less and less elevated, more and more extended, till the broad, bony scales of the Coelacanth armour would result, and until scales, at first merely in contact, would gradually so overlap, that two-thirds of each would be covered as in a slate-roof. Now, different families of ganoids, Acanths, Diptereans, Palaeonisci and Coelacanths, do approximate, in different degrees, to the shagreen scales of the placoids. But all the Coelacanths, including the Asterolepis,—"that first, hugest ganoid,"—differ most widely from the silurian placoids in their scales. And, as it will furnish an apt illustration of Mr. Miller's skill and acuteness in reading the characters and relations of extinct fishes, in their bony and entombed relics, we cite the paragraph in which he sums up the results of his examination of the scales:—

"The scaly cover of the Coelacanths was a cover on the slate-roof principle. There was, in some of their genera, about one third more of the scale covered than exposed. It was *farthest* removed, in character, from shagreen, as that of their cotemporaries, the Acanths, approximated to it most nearly: they were, in this respect, the two extremes of their order. And, did we find the Coelacanths in but the later geological formations, while the Acanths were restricted to the earlier, it might be argued by the asserters of the development hypothesis, that the amply imbricated, slate-like scale of the Coelacanth had been developed, in the lapse of ages, from the shagreen tubercle, by passing, in its downward course—broadening and expanding as it descended—through the minute, scarcely imbricated disks of the Acanths, and the more tile-like rhombs of Dipterians and Palaeonisci, until it had reached its full extent of imbrication, in the familiar modern type exemplified in both the Coelacanths and the ordinary fishes. But such is not the order which nature has observed. The two extremes of the Ganoid scale appear together in the same early formation. Both become extinct in a period geologically remote; and the scales of the existing state of things, which most nearly

resemble those of ancient time, are scales formed on the intermediate or tile-roof principle."

If those readers, who are not familiar with details of ichthyic palæontology, will now accompany us through a few dry paragraphs, we will endeavor to give them some idea of the acumen, talent for observation, and skill in comparative anatomy, with which the author lays the broad, deep, and immovable foundation, on which he bases his conclusions with regard to the high organization in the class of fishes, and the extraordinary size of the Asterolepis.

We know not how it may have affected others, but we read no part of the work with such intense interest as the new, striking, wonderfully conclusive processes of anatomical analysis and comparison, by which, with the aid of distinct and beautiful cuts, the author refutes Oken's theory of the development, by light, of nerves in pairs; and, by these nerves, the supposed four cranial vertebræ, even in man's head, corresponding to the four senses seated in the head;—shows why the perishable, internal, cartilaginous, cerebral box of Placoid and Ganoid fishes are not found in the oldest rocks;—points out its structure, studded *externally*, under shagreen skin, with star-like bony points, destitute of sutures, and perforated with holes for the passage of nerves, while the *proper vertebræ* of the same animal have the bone internal and the cartilage external;—proves that the well-preserved bony buckler, which formed an external skinless shield around the cartilaginous brain-box of the Ganoids, Cælacanths especially, corresponds to the internal skin-covered bony brain-box of the cod, taken as the best type of existing fishes;—demonstrates a most manifest correspondence in number, position and form, between the internal cranial bones of the cod and the external ones of the Coccosteus, Osteolepis, Asterolepis, and other ganoids;—finds in the under jaws "strongly-marked bones in at least all the Dipterian and Coelacanth genera,"—a true union of the external with the internal skeleton, and the first indications of teeth in bony sockets;—traces in the under jaw of one a striking resemblance to that of a quadruped, with a mode of articulation that probably admitted the lateral motion exemplified by man himself;—and triumphantly exhibits, in a section of the cranium of another, "the two very important cranial cavities, the brain

pan proper, and the passage through which the spinal cord passed into the brain, ... the most ancient brain pan on which human eye has ever yet looked, ... and the type of cell in which, myriads of ages ago, in at least one genus, that mysterious substance was lodged, on whose place and development so very much in the scheme of creation was destined to depend."

Having given a restoration of the head of a Dipterian Ganoid, nearly allied to the Asterolepis, he says:

"This profile, the result not of a chance-drawn outline arbitrarily filled up, but produced by the careful arrangement in their proper places of actual plates, serves to show how perfectly the dermo-skeletal parts of the creature were developed. Some of the animals with which we are best acquainted, if represented by but their cuticular skeleton, would appear simply as sets of hoofs and horns. Even the tortoise or pengolin would present about the head and limbs their missing portions, but the dermo-skeleton of the Osteolepis, composed of solid bone, and burnished with enamel, exhibited the outline of the fish entire, and, with the exception of the eye, the filling up of all its external parts. Presenting outside, in its original state, no fragment of skin or membrane, and with even its most flexible organs sheathed in enamelled bone, it must have very much resembled a fish carved in ivory; and, though so effectually covered, it would have appeared, from the circumstance, that it wore almost all its bone outside, as naked as the human teeth."

Finding no trace of those cerebral vertebræ, of which a skull is regarded by Oken and his disciples as developments, the principle is successfully sought, which rendered it necessary, that the geologically earliest divisions of it, found in the dermal skulls of the first Ganoids, (as the Asterolepis,) should correspond with the divisions, not merely of the internal osseous skulls of existing fishes, but with those also of other higher animals, man not excepted. Of the solid parts of the ichthyic head, some plates afford protection to the brain; and being, therefore, passive, are firmly united, as in the cranial buckler of all Ganoids;—while others, contributing to such functions as mastication and respiration, and therefore requiring active motion, are separate and susceptible each of independent motion, like the lower jaw of Dipterus or the hyoid plate of Asterolepis. In these parts of an osseous wall, for the

protection of the chief animal organ in a cavity, means of adjustment to any required dimensions or form of that cavity, if, as Harris contends, in his Pre-Adamite Earth, a manifestation of Divine All-Sufficiency was a ruling motive, must have been provided. This provision we find in all the Ganoid skulls. Hence, the greatest living naturalist, Professor Owen, of London, says:

"The recognition of an ideal exemplar" in the Ganoid fishes and in other Paleozoic vertebrata, "for the verfebrated animals, proves that the knowledge of such a being as man existed before man appeared; for the Divine mind, which planned the archetype, also foreknew all its modifications. The archetypal idea was manifested in the flesh, under divers modifications, upon this planet, long prior to the existence of those animal species that actually exemplify it."

The high cerebral organization of the Coelacanths, the family of fishes to which the Asterolepis belonged, being thus established, the author enters on the consideration of that animal, in order to ascertain its structure, bulk and aspect.

Its remains, subjected to a most rigid examination, yield to the philosopher many secrets, that have been, countless ages, locked up in the rocky volume of its own and of the history of its cotemporaries. The large scales—enamelled plates of bone—which completely shielded the creature's body, each covered with star-like tubercles, resembling little hillocks; and the ponderous cranial buckler, "large enough to have covered the skull of an elephant," and yet strengthened, within and without, by three longitudinal ridges, converging from the base to a point near the snout, and between the eyes, and by a transverse cross-beam,—so that the head of the largest living crocodile is defended by an armature greatly less strong,—indicate that it must have had, in those ancient seas, still more powerful assailants to resist, but whose remains have not yet been found. The cranium, dissected and examined, exhibits, like other fishes, "the same bones, though much subdivided, that exist in the skulls of other vertebrata;" and, in each piece, channeled markings between the osseous fibres radiate from a centre of ossification, as "in the cerebral bones of the human fœtus." The under jaws,—consisting of two pieces joined in front, as in placoid fishes, and also in quadrupeds,—

studded all round near the edge of the bony lip with thickly-set ichthyic teeth, "like iron spikes in the upper edge of a gate," and within these, on an interior platform, a thinly-set row of huge, striated, pointed, double-edged, reptilian teeth,—symbolize the coming reptile—show us the crocodile entrenched behind the fish. They prove, also, that the animal was carnivorous. The hip-bone is constructed on the same type as that of the higher fishes, and even of quadrupeds and monkeys. The coprolites contain scales of Dipterians, and teach us that the Asterolepis devoured smaller, but formidable, carnivorous, buckler-headed cotemporaries;—yea, more, that the intestine contained, in perfection, "the winding, cork-screw, spiral" contrivance, found in some animals, "as the amphibious quadruped, called sea-fox," to which Paley refers, in his chapter on compensating contrivances, and of which he says, "here the shortness of the gut is *compensated* by the obliquity of the perforation." The nail-like hyoid bone, found at Stromness, and others much larger, subsequently obtained, complete the chain of evidence necessary for ascertaining the rule of measure—"*module*, as the architect might say—by which the proportions of the rest of the creature were regulated." And what was its size? The rule of measurement admits of variations; and hence, we are informed, that the individual that left the largest bones yet discovered, "if built in the shorter proportions, must have been eighteen, and, if in the longer, twenty-three feet in length."

"Thus, in the not unimportant circumstance of size, the most ancient Ganoids yet known, instead of taking their places, agreeably to the demands of the development hypothesis, among the sprats, sticklebacks, and minnows of their class, took their place among its huge, basking sharks, gigantic sturgeons, and bulky sword-fishes. They were giants, not dwarfs."

"Instead of being, as the development hypothesis would require, a fish low in its organization, it seems to have ranged on the level of the highest ichthyic reptilian families ever called into existence. Had an intelligent being, ignorant of what was going on upon earth during the week of creation, visited Eden on the morning of the sixth day, he would have found in it many of the inferior animals, but no trace of man. Had he returned again in the evening, he would have seen, installed in the office of keep-

ers of the garden, and ruling with no tyrant sway, as the humble monarchs of its brute inhabitants, two mature human creatures, perfect in their organization, and arrived at the full stature of their race. The entire evidence regarding them, in the absence of all such information as that imparted to Adam by Milton's angel, would amount simply to this, that in the morning man was not, and in the evening he was. There, of course, could not exist, in the circumstances, a single appearance to sanction the belief that the two human creatures, whom he saw walking together among the trees at sunset, had been "developed from infusorial points," not created mature. The evidence would, on the contrary, lie all the other way. And in no degree does the geological testimony respecting the earliest Ganoids differ from what, in the supposed case, would be the testimony of Eden regarding the earliest men. Up to a certain point in the geological scale, we find that the Ganoids are not; and when they at length make their appearance upon the stage, they enter large in their stature, and high in their organization."

And what must have been the aspect of this "oldest of Scottish fishes," much more bulky than "a large porpoise," the author leaves us to imagine. Let the reader, who may have seen a large shark, saw-fish or sword-fish of existing seas, contrast it mentally with an Asterolepis, twenty feet in length, shielded in its brilliant enamelled coat of mail—(more elaborately carved than that of Charles V., though manufactured in the age of Cellini)—with its large, prominent eyes, far forward in its broad bony-buckler-ed head, which must have had the sinister aspect of a reptile watching its prey. Let him fancy it darting near the surface and glittering in the sun's rays, with its enormous mouth, fenced all around and within with rows of spike-like teeth, ready to seize a Dipterian fish, and crush with a crashing sound its bony carapace, and he may form some conception of its aspect.

Our classic readers will remember the notion "of the philosophers of antiquity, with whom it was a received maxim, that created things were always most perfect, when they came first from the hands of their Maker; and that there was a tendency to progressive deterioration in sublunary things, when left to themselves;

"'—— Omnia fatis
In pejus ruere, ac retro sublapsa referri.'"

This beautiful passage, in Lyell's masterly examination and rejection of the Lamarckian hypothesis, in three long chapters of the Principles of Geology, occurred to us, when we had concluded Mr. Miller's description of the Asterolepis; for Lyell, after stating the opinions and arguments of Lamarck and his followers, says, "the tables were completely turned on the philosophers of antiquity." We felt that the tables had been completely turned again on the "mystic" Oken, the "dreaming" Lamarck, and the "ingenious" author of the "Vestiges."

The reader's attention has been confined to the Asterolepis. It did not exist alone. Its Ganoid order embraced numerous other genera, some of which are very little inferior to it in size or organization. Though found in all subsequent times, the ganoids must have swarmed in the oceans of the Old Red Sandstone period; for our author says, if the trade were once fairly opened up, the Orkneys alone could furnish tons and ship-loads of their remains for the museums of the world; and the period must have been sufficiently protracted for the deposition of rocks of various kinds, thicker than the loftiest Scotch mountains; for of those rocks the mountains mainly consist. The Asterolepis, however, bore to its order the relation of superiority, which the lion bears to that of Carnaria; the elephant to Pachydermata; and the orang-outang to Quadrumana. Other animals—radiate, molluscous, and articulate—existed in countless numbers, forming classes, orders, families, and genera, some of which still exist, and the species of which were marked by characters quite as distinctive as those of the human era. Truly, to the very bottom of the oldest system of rocks, save one, the Lamarchians can find no foundation on which to rest their hypothesis, and claim for it the support of geologists. The geologist discovers in the rocks evidences of *degradation*,—confirmation of the opinion of the ancient philosophers; for the Ganoids have certainly retrograded slowly in all later periods, and have their analogues, now, in the sturgeon. Through the various formations and subdivisions of that oldest system, the Silurian, the dawn of organic existence, we now propose to proceed to the very bottom, if the reader will accompany us, confining our attention to the ichthyic class.

The Silurian are marine strata ten thousand feet in thickness; and all geologists admit that their deposition, from abraded fragments of pre-existing rocks, required the long periods of time, demanded by the author of the "Vestiges." As but a few traces of fish had, ten years ago, been found in the upper series, and none in the lower divisions or formations, though remains of corals, mollusca, and articulata (*trilobites*) constitute mountain masses in England, Russia, the United States, and many other countries, where "there were many hands and eyes busy" in search of them, the author of the Vestiges, in his volume of "Explanations," founding his argument on the presumed fact of their total absence, boldly said, "*I fix my opponents down to the consideration of this fact, the earliest formations contain no fish.*" Fortunately, great advance has since been made in this branch of palaeontology. The author gives a minute history of the progress of discovery, referring to Murchison, Sedgwick, Agassiz, Phillips, and the New York geologists. The results are briefly given in the subjoined table, to which we add the metamorphic, non-fossiliferous rocks:

Upper Silurian Rocks.	Upper Ludlow.	1	Fish, 1838. (Murchison.)	*Metamorphic Rocks. Cambrian—Lowest Silurian.*	Plynlimmon Group.	8	None yet.
	Aymestry Limestone.	2	Fish, 1842. (Phillips.)				
	Lower Ludlow.	3	None yet.		Bala Limestone.	9	Fish, 1847, (Geologists of English Government Survey.
	Wenlock Limestone.	4	Fish, 1845. (Sedgwick.) Fish, 1846. (N. Y. Geologists.)		Snowdon Group.	10	Fucoids.
Lower Silurian.	Wenlock Shale.	5	Fish, 1847. (Phillips.)				
	Caradoc Sandstone.	6	None yet.		Gneiss, &c. Mica Slate.		No fossils of any kind.
	Llandeilo Flags.	7	Fish, 1847. (Sedgwick.)				

Thus, the bold challenge of the latest and most ingenious defender of the law of development has been met, successfully, by the conclusive proof of the actual occurrence of the remains of fish, at the very bottom of the fossiliferous series. The first question is *not*, were they

numerous? For though, from those found in one bed, Agassiz formed six *genera*, and though the cartilaginous nature of their internal skeletons, and the minuteness of the shagreen points or plates on their skins, forbid the hope of finding their remains abundant in rocks deposited, perhaps, myriads of ages before the period of the Old Red Sandstone began, the occurrence of one bone, unequivocally that of a fish, in solid rock, like that of the Bala Limestone, establishes the existence of the *class* at that time, as clearly as a thousand. The question is, were they minute, mere ichthyic fœtuses and embryos?

The scales, teeth, jaws, and spines of Silurian fish hitherto discovered, have been referred by ichthyologists, with entire unanimity, to the Placoid order of Agassiz. And by a careful comparison of some of these, especially the fossil defensive spines, that formed the anterior mast-like supports of their fins, with those of living fishes, Agassiz discovered "an affinity to the genera Cestracion, Centrina and Spinax." By instituting a comparison of the defensive spines from the first and ninth,—the highest and lowest Silurian formations,—Upper Ludlow and Bala Limestone, (see preceding table,) with those of *Spinax Acanthias* (dog fish) and *Cestracion Phillipsii* (Port Jackson Shark,) he finds the fossil spines more than twice as long and thick as those of the existing animals. The same is true of fossil spines found in the Onondaga limestone, New York. These fishes are, therefore, inferred to have doubled in size the Port Jackson Shark of our times. The assertors of the development hypothesis appealed to geological evidence, expecting that, should fishes be discovered in the lowest Silurian strata, they would be microscopic; "and straightway witnesses enter court. But lo! among the expected dwarfs, there appear individuals of more than the average bulk and stature." Never were a set of theorists more effectually driven to the wall: and the author's apology for "tedious minuteness of descriptions, and a too prolix amplitude of statement," was, though in keeping with the modesty gracefully exhibited on every page, wholly unnecessary; for his wonderfully graphic descriptions of objects, and lucid statements of facts, impart a charm to the work, which holds the reader spell-bound, even in the perusal of its most abstruse portions.

Having established the large size of some, at least, of the first fossil fishes, the question remains, and it is the principal one, "did these ancient Placoid fishes stand high or low in the scale?" of being,—"were they high in intelligence and organization?" Must they be placed in these respects, though not in size, above the Ganoids?

Professor Sedgwick had previously maintained, that if we regard "the brain, and the whole nervous, circulating and generative systems, they stand at the highest point of a natural ascending scale, the very highest types of their class." By a learned process of investigation, requiring a profound knowledge of all the systems of classification, Linneus's, Cuvier's, Muller's, Owen's and Agassiz's, and of the principles on which they depend, the author strips the whole subject of "the entanglement and perplexity," in which the Lamarckians attempted to involve it, in order to show that, as many *cartilaginous* fishes stand low in the scale; so, of the general inferiority of all, there can be no doubt. The true question is, not as to the *cartilaginous* fishes,—a mere subterfuge of the "Vestiges,"—but "the *Placoid* fishes of the Silurian Rocks." More important principles in classification than an internal cartilaginous skeleton, induced Linneus to place the Placoids "above fishes altogether, by erecting them into an order of reptiles,—*Amphibia Nantes.*" The system of Muller, modified by Owen,—"now regarded as most natural,"—places the cartilaginous ichthyic worms in the first and lowest order, and most of the Placoids—"ichthyic reptiles"—in the eleventh and highest order of fishes, the Plagiostomi. The Placoid and Ganoid orders of Agassiz, "stamped in the mint of nature," are real; and if the questionable Ctenoids and Cycloids were thrown into one—the horn-covered—the three orders would correspond, in the order of their appearance, to the three great geologic periods,—Palaeozoic, Secondary and Tertiary,—and to the order of their arrangement in "Cuvier's Animal Kingdom,"—the highest in the scale appearing first in geologic time.*

* And the great "defect" in Agassiz's system is, not in the principle of classification, but in the arrangement of fishes. When the absence of scales left him without a guide, he resorted to the principle of Cuvier,—his great teacher—the presence or absence of a cartilaginous, internal skeleton, forgetting that the Placoids have an osseous external covering, while the lower

In accordance, then, with all principles of classification, the Silurian Placoids *rank high in the scale of organization.*

And what was the rank in intelligence of the Placoids of the Silurian seas? To determine this point, we must ascertain with what organ or combination of organs, instinct and intelligence are most intimately connected. If rank depended on solidity of bone, all birds, all carnivorous, and many herbivorous quadrupeds, would take precedence of man. Development of brain, not solidity of bone, is the correct principle on which animal rank depends. In the lowest, *Acrite*, division, nervous matter is wholly absent; and as we ascend in the scale of being, the nervous ganglia increase, till we reach the highest; and examination of the four classes of vertebrata shows, that in fishes, the brain bears to the spinal cord the average proportion of 2 to 1; in reptiles, $2\frac{1}{2}$ to 1; in birds, 3 to 1; and in mammals, 4 to 1; while in man, it is 23 to 1! And of this the author of the "Vestiges" was sensible; for though, when it suited his purposes, in reasoning concerning the fishes, he made an internal bony skeleton the criterion of rank; yet, when he traced man's origin through monkeys to the dolphins, (whose bones, according to Owen, are but little removed from cartilage) he appeals, in support of man's affiliation to his marine progenitors, to "the great development in the brain of the dolphin family." The Placoids, as we have seen, possess a compound internal skeleton,—in the head, cartilaginous within and osseous without, and, in the vertebræ, bony within and cartilaginous without.

Is the cerebral mass of existing Placoids largely developed? In reply to this question, our author says, that having examined the brains of all the fishes on the Scotch coast, he found invariably the largest brain, in proportion to the size of the body, in the dog-fish, rays and other placoid fishes. And to this superior relative magnitude of brain, all fishermen attest that they possess a corresponding superiority of instinct and "shrewd caution," "both in

cartilaginous fishes have no bone at all, and *a soft slimy skin* like worms, being, indeed, far below several of that class, not merely in the brain, nerves and organs of circulation and generation, but in effective means of offence and defence.

watching their prey, and in avoiding the fisherman's hook and the meshes of his net."

In their reproductive organs, they rank with chelonians and reptiles. Among the rays, individual attachments are formed between male and female. Their eggs, like those of the tortoise and crocodile, are of considerable size. Their young pass through no such metamorphoses as those of even the salmon, the toad, and the amphibia generally. And some, the dog-fish especially, to which Agassiz found the Silurian placoids nearly related, are ovoviviparous, and bring forth their young alive and fully formed.

But, say the Lamarchians, "is not embryonic progress the key to the classification of animals," and is not the cartilaginous structure of the placoid skeleton analogous not merely to the embryonic skeleton of the bony fishes, but of vertebrated animals in general? Not at all. The placoid skeleton, we have seen, has true bone external in the head and on the skin, and internal in the vertebræ; and, moreover, the so-called cartilage of the placoids is chemically different, as a simple experiment demonstrates, from that of embryonic bony fishes, birds and mammals; for the former is insoluble in boiling water, while the latter is completely soluble.

And what, say you, asks the author of the "Vestiges" to the one-sided, heterocercal tails of the placoids? Is it not a characteristic of the embryos of the bony fishes—of the young salmon just burst from the egg? If we admit that a one-sided tail is a sign of immaturity in the young of one set of animals; is it a proof of inferior organization in the adults of another? The young Balanus has two eyes, which it loses at maturity, and then passes its days in darkness. The immature Lepas swims freely, but the mature animal, fixed to a rock or log, is no longer able to swim. The negro infant is nearly white, but as it advances in age its color gradually deepens into jet black. Are eyes, organs of motion, and a white skin mere embryonic peculiarities,—evidences of a low and not of a high standing? If not, on what principle can the heterocercal tail of the placoids, counteract all evidence derived from brain, instinct, organs of generation, individual attachments, viviparous production of fully formed young, and a bony skeleton covered with a substance which,

though apparently cartilaginous in physical characters, is wholly different in chemical properties? Is the heterocercal or one-sided tail of the placoids not an evidence of superior rank? In the osseous fishes, the vertebral column terminates abruptly, and expands into a broad fin of osseous rays enveloped in soluble cartilage. This surely is a sign of *degradation;* for when the one-sided tail of a recent placoid, (Spinax Acanthias) was boiled and burned, it lost much of its icthyic character, and acquired, instead, a striking resemblance to the pointed bony column in the tail of the Saurian animals.

The author of the "Vestiges" ridicules the mouths of most of the recent placoid fishes, which open under the head, as a marked embryonic feature. To this it would be a sufficient reply, that the *lowest* fishes, the *Suctorii*, have the mouth at the anterior termination of the muzzle; and that some *bony* fishes, as the distorted asymmetrical *Platessa*, (a genus in no way superior to its bony neighbors,) have the mouth in the upper side of the snout, which gives them "an expression of unmistakeable stupidity." But the objection is susceptible of a much more conclusive reply. Egerton, Agassiz, Sedgwick and Forbes trace the Silurian fishes to the Cestraciont family of the placoids, and the *Cestracion Philipsii*, or Port Jackson shark, (the sole surviving species of the oldest vertebrate family of Creation,) has its mouth (according to Wilson, in the "Encyclopedia Britannica,") "at the extremity of the pointed muzzle." And in Agassiz's "Tabular View of the Genealogy of Fishes" "the Cestracionts, and they only, sweep across the entire geologic scale." This first family, having passed in various generic and specific forms, but in gradually decreasing numbers, through all geological periods, has one living species left; and of its mouth Miller said, after he had examined a fine specimen in the collection of Prof. Fleming:—

> "The mouth, instead of opening, as in the ordinary sharks, under the middle of the head, to expose them to the suspicion of being creatures of low and embryonic character, opened in a broad, honest-looking muzzle, very much resembling that of the hog. The mouths of the most ancient placoids of which we know anything, *did not*, I reiterate, *open under their heads.*"

Thus, having clearly shown that embryonic develop-

ment is not the key to the theory of development, *but of fœtal development;* that embryonic progress is fœtal development, and nothing more; and that gestation is not creation, Mr. Miller says:

"It is one of the difficulties incident to the task of replying to any dogmatic statement of error, that every mere annunciation of a false fact or false principle must be met by elaborate counter-statement or carefully constructed argument, and that prolixity is thus unavoidably entailed on the controversialist, who labors to set right what his antagonist has set wrong. The promulgator of error may be lively and entertaining, whereas his pains-taking confutator runs no small risk of being tedious and dull. May I, however, solicit the forbearance of the reader, if I spend a little time more in indicating what I deem the proper ground, on which the standing of the earlier vertebrata should be decided. To the test of *brain* I have already referred, as all-important in the question: I would now refer to the test of what may be termed *homological symmetry of organization.*"

In the discussion of this test the author unfolds and sustains, with an irresistible array of facts and arguments, his striking and strangely interesting theory of *Degradation.* It was our intention, when we began this article, to give the reader an outline of this theory; but our limits forbid it at present. We will, perhaps, resume the subject at this point in the next number.

This is a scientific age, and we cannot close this article without inviting the special attention of those, who have control of the course of education in our Colleges, and in Theological Seminaries especially, to the subjoined paragraph:—

"It is always perilous to under estimate the strength of an enemy; and the danger from the development hypothesis to an ingenious order of minds, smitten with the novel fascinations of physical science, has been under estimated very considerably indeed. Save by a few studious men, who, to the cultivation of geology and the cognate branches, add some acquaintance with metaphysical science, the general correspondence of the line of assault taken up by this new school of infidelity, with that occupied by the old, and the consequent ability of the assailants to bring, not only the recently forged, but also the previously employed artillery into full play along its front, has not only not been marked, but even not so much as suspected. And yet, in order to show that there actually is such a correspondence, it

can be but necessary to state, that the great antagonist points in the array of the opposite lines, are simply the law of development versus the miracle of creation."

"But, ere the churches can be prepared competently to deal with it, or with the other objections of a similar class, which the infidelity of an age so largely engaged as the present in physical pursuits will be from time to time originating, they must greatly extend their educational walks into the field of physical science. The mighty change which has taken place during the present century, in the direction in which the minds of the first order are operating, though indicated on the face of the country in characters which cannot be mistaken, seems to have too much escaped the notice of our theologians.

"Speculative theology and the metaphysics are cognate branches of the same science; and when, as in the last and the preceding ages, the higher philosophy of the world was metaphysical, the churches took ready cognizance of the fact, and, in due accordance with the requirements of the time, the battle of the evidences was fought on metaphysical ground. But, judging from the preparations made in their colleges and halls, they do not now seem sufficiently aware,—though the low thunder of every railway, and the snort of every steam-engine, and the whistle of the wind amid the wires of every electric telegraph, serve to publish the fact,—that it is in the departments of physics, not of metaphysics, that the greater minds of the age are engaged,—that the Lockes, Humes, Kantes, Berkeleys, Dugald Stewarts, and Thomas Browns, belong to the past,—and that the philosophers of the present time, tall enough to be seen all the world over, are the Humboldts, the Aragos, the Agassizes, the Liebigs, the Owens, the Herschels, the Bucklands and the Brewsters. In the educational course through which, in this country, candidates for the ministry pass, in preparation for their office, I find every group of great minds which has, in turn, influenced and directed the mind of Europe for the last three centuries, represented, more or less adequately, save the last. It is an epitome of all kinds of learning, with the exception of the kind most imperatively required, because most in accordance with the genius of the time. The restorers of classic literature, the Buchanans and Erasmuses, we see represented in our universities by the Greek, and what are termed the Humanity courses; the Galileos, Boyles and Newtons, by the Mathematical and Natural Philosopy courses; and the Lockes, Kantes, Humes and Berkeleys, by the Meatphysical course. But the Cuviers, the Huttons, the Cavendishes and the Watts, with their successors, the practical philosophers of the present age,—men whose achievements in physical science

we find marked on the surface of the country in characters which might be read from the moon,—are not adequately represented.

"It would be, perhaps, more correct to say, that they are not represented at all; and the clergy, as a class, suffer themselves to linger far in the rear of an intelligent and accomplished laity —a full age behind the requirements of the time. Let them not shut their eyes to the danger which is obviously coming.

"The battle of the Evidences will have as certainly to be fought on the field of physical science, as it was contested in the last age on that of the metaphysics. And, on this new arena, the combatants will have to employ new weapons, which it will be the privilege of the challenger to choose. The old, opposed to these, would prove but of little avail. In an age of muskets and artillery, the bows and arrows of an obsolete school of warfare would be found greatly less than sufficient in the field of battle, for purposes either of assault or defence."

ARTICLE VII.

CRITICAL NOTICES.

1. *Report of a General Plan for the Promotion of Public and Personal Health, devised, prepared and recommended by the Commissioners appointed under a resolve of the Legislature of Massachusetts, relating to a Sanitary Survey of the State. Presented April 25th,* 1850. *Boston: Dutton and Wentworth. pp.* 544, 8*vo.*

The vast importance of the object of this report is felt and acknowledged by every man who devotes one moment's thought to the consideration of the subject. Time and labor are well employed in investigating the causes which render mankind liable to disease, and which have a tendency to shorten the brief span of existence allowed him in this world. Not more than half of those who enter into life are found to run this short race, and even then how frequently is it terminated by disease. It was