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AN ADDRESS

ON

THE SPHERE, INTEREST AND IMPORTANCE OF  
GEOLOGY.

DELIVERED DECEMBER 8, 1849,

IN THE

HALL OF THE HOUSE OF REPRESENTATIVES,

BY

R. T. BRUMBY, M. A.

PROFESSOR OF CHEMISTRY, MINERALOGY, AND GEOLOGY, IN THE SOUTH

CAROLINA COLLEGE.

PUBLISHED BY THE TRUSTEES.

COLUMBIA, S. C.  
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SOUTH CAROLINA COLLEGE, COLUMBIA, }  
December 12th, 1848. }

To Professor R. T. BRUMBY:

*Sir*:—I have the honor to notify you, that the following resolution was adopted by the Board of Trustees of the South Carolina College, at its last meeting, to wit:

"*Resolved*, That Professor BRUMBY be requested to deliver a public address, on some subject connected with his Professorship, in the College Chapel, on some day in December next, that may suit his convenience."

Very respectfully, your ob't. serv't.

JAMES D. BLANDING,  
*Sec'y. Board of Trustees S. C. College.*



## ADDRESS.

Men speak habitually of this as the scientific age; and truly, too, if they intend merely to contrast it with any preceding period, in the number of scientific men, the zeal with which researches are prosecuted, and the magnitude of the results of scientific discoveries; for now, vessels cross the Atlantic in ten days, one steam-engine accomplishes daily the labor of 260,000 men, and, in the morning, we will read, in some paper, events that are transpiring, this evening, in Charleston and Quebec, Boston and New Orleans, New York and St. Louis.

Indeed, science, applied to art, has wrought such changes, that we are inclined to rest satisfied with what has been done, and to look forward only to new applications of known principles, or additional inventions of labor-saving machines. This is a great mistake. Man's Creator "made him a little lower than the angels," and "put all things under his feet," with the command to "replenish the earth and subdue it." How imperfectly this injunction has been obeyed, is most sensibly felt by scientific men, who reflect daily on recently discovered, comprehensive principles, that have not been applied to any practical purpose, and who are aware that many useful substances occur in abundant, comparatively useless compounds, as potash in gneiss, and sulphuric acid in gypsum, which have baffled all investigators in their attempts to separate them, cheaply and profitably, from their native combinations. Man's power is certainly not exhausted; and the fields of nature, in which fresh conquests may be made, are boundless.

In these fields, disinterested, laborious devotees of nature are patiently searching to discover hidden sources of wealth, concealed principles of science, and new modes of applying those that are known; yet, they encounter so many obstacles in the ridicule of ignorance, the suspicion of bigotry, and the neglect of governments, as well as in the intrinsic difficulty

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of raising the veil that conceals Nature's secret processes, that their progress is slow and silent. Occasionally, such success as the conversion of lard into adamantine candles, the use of polarized light in the manufactory of sugar, or the detection of poisonous adulterations of drugs and medicines, and the employment of the microscope in discovering the animalcular origin of virulent disease, excites attention to their pursuits. Still, they are soon forgotten. The world receives, too often without appreciating, certainly without giving them credit for, the results of their toils. How few know that the protracted, patient, ingenious researches of a London chemist, Faraday, established the fundamental principles of Morse's Telegraph, and that when Morse announced his success, several others claimed the honor of original invention.

This age is merely the brilliant dawn of physical science. It consists of systematized, intelligible expressions of the laws of nature; and as these laws partake of the infinity of their Divine Author, they will probably require many centuries for such a development of them, as is designed by Providence, for the perfection of man's powers—the limit to his ability to replenish and subdue the earth.

It is demonstrable, however, that the accelerated progress of the world in wealth, refinement, knowledge, morality and religion—all the elements of civilization—is attributable, in a great degree, to the advance made in the numerous branches of physical science; and it is difficult to conceive how any enlightened community can hope to secure its highest interests, or to discharge its duties to the rest of mankind, without making systematic, expensive efforts to extend the sphere of science, and thereby to increase man's "dominion over the works of God's hands."

Yet, in South Carolina, the study of even the elements of some of the most comprehensive, fascinating, and useful branches of physical science, has been almost wholly excluded, for ten or fifteen years, from our highest seminaries of learning. Hence, I propose, on this occasion, to vindicate the claims of Geology to public attention, by attempting to point out briefly its sphere, interest and importance.

I am aware, as Mantell says, that "such is the consum-

mate perfection of all the works of the Creator, that every inquirer discovers a surpassing worth, and grace, and dignity, in that special department, to which he has peculiarly devoted his attention. Whatever the walk of philosophy on which he may enter, that will be the path which, of all others, will be to him the most enriched, by all that is fitted to captivate the intellect, and excite the imagination."

Still, though convinced that, in the whole circle of human sciences, there is none that offers its votaries rewards more varied, more inexhaustable, or more wondrous—none that unfolds more of the mysteries of the material world—none that secures to man, in a greater degree, dominion over the natural world; yet, I disclaim all disposition to institute a comparison between Geology and any other branch of knowledge. All knowledge is power; and any that is fitted to enlarge his mind, refine his manners, soften his heart and humanize his soul, is worthy of man's ardent pursuit. Geology, as I hope to prove, is eminently qualified to produce all these effects; and, therefore, it ought not to be longer generally neglected.

It is proper, however, before I begin the discussion of the subject, to ask your indulgent attention to some prefatory remarks, on the state of mind required by such studies, and on the special relations of Geology to Revelation.

Geology, like all the studies of nature, teaches the erroneous, unphilosophical character of our common ideas—our habitual impressions; and hence, like them all, it warns us to doubt the evidence of our senses, with regard to material phenomena, until that evidence is demonstrated by facts—by actual observation, experiment, and, when practicable, calculation—to be true. In all such studies, we ought, therefore, if truth, not triumph, be our object, to renounce our preconceived opinions (such as those that relate to the motion, shape, size, and importance of the earth,) and to strive to keep our minds ever in a waiting, impressible frame, ready to weigh the evidence of phenomena, (natural appearances, as the rising and setting of the sun,) whether such evidences tend to confirm or subvert our most cherished theories and opinions.



Thus, the child runs in pursuit of the moon; the savage and peasant think the earth is an immovable plain; many educated men believe the rocks are confusedly thrown together; and all, who are ignorant of geology, regard existing continents, islands, oceans and seas, as having been essentially the same, in all past periods of the earth's history. So true is this, that should you say to one, unacquainted with geology, that the site of Columbia was once, not a remote geological period, near a sea beach, in proximity to which volcanic fires had forced, through numerous fissures, the fluid matter that now forms the trappean dykes in the North West parts of the State, he would listen to you with incredulity, and, perhaps, treat you with derision or pity.

A little experience teaches the child that the moon is ever at the same relative distance from him; a few lessons in physical geography, convinces the peasant that the earth is one of several minor spheres, that revolve round a stationary sun; a little investigation, in river banks, sea beaches, and mountain declivities, unfolds to educated minds the great law of stratification, which teaches the order in which rocks lie regularly superimposed on each other, like the leaves of a printed volume; and geologists have learned to read, on the pages of this great rocky history, in characters impressed indelibly by the hand of time, legible histories of numerous changes, through which the planet has passed, since the matter of which it consists was commanded to be "In the Beginning."

We habitually regard stones and rocks as having ever been the refractory, unyielding objects, which we now behold them. Geology proves that all rocks, all stones, how hard soever they may be, once, many of them frequently, were soft and impressible in the state of sand, or mud, or fluid.—The proofs consist not of arguments from analogy, but of incontrovertible facts, seen in rolled pebbles cemented into stone; angular fragments united into a mass; impressions of rain drops and ripple marks on the plains of stratification, deep in the bases of the old hills; above all, of beautifully distinct impressions of leaves, bark, stems, roots, stumps and trunks of trees; and of delicate, perfectly preserved, shells, teeth, fins, wings, tracks, claws, bones, and even eyes of ani-

mals, which are found every where in mines, natural chasms, and in Alpine heights, thousands of feet below the present surface.

This tooth of a shark (*Lamna elegans*) was taken up by an Artesian auger, from a depth of 482 feet below the surface, in the elevated, central portion of cretaceous rocks in Alabama. It was in contact with this piece of fossil wood, pierced and bored by a marine animal, the *teredina*, (*Teredo tibialis, Mart.*) Both tooth and wood were mixed with mud, and sand, and water-worn pebbles, and fragments of shells. These are facts; and who can hesitate to deduce from them conclusions, which force themselves on every mind, that that now elevated part of central Alabama was once the bed of a sea, in which sharks sought the indulgence of their carnivorous propensities; that it was near some shore or estuary, in proximity to the land on which the tree grew; that a part, perhaps a branch, of the tree was torn off by wind, flood, or some other force, and thrown into some river; that the wood drifted about in the sea, till the teredina settled upon it, bred in it, and perforated it; and that, finally, it subsided to the bottom, to be mixed with sharks' teeth, mud, gravel, and shells.

These slabs are from the Red Sand-stone, in a deep chasm, cut by the Connecticut river, in the mountains of Massachusetts. The rock constitutes a large portion of the elevated region from Massachusetts to South Carolina, at the base of the mountain chain, and parallel to the Atlantic. It is covered, geologically, by rocks several thousand feet thick; and, in England, the same rock is more than 8000 feet below the level of existing alluvial depositions. This slab contains numerous impressions, perfectly distinct, of what every boy recognizes as tracks of birds; this, the tracks of a quadruped, perhaps a reptile, in regular succession, as it walked or crawled; this, numerous marks of drops of rain; this, ripples caused by waves; and this, a fish—head, body, tail, fins, scales, and eyes. I utter not my own interpretation of these facts, but that of the scientific world, when I say, all laws of evidence compel us to admit that the now elevated portion of country, deep in the strata of Massachusetts, from which these slabs came, was once sand and mud, slowly accumu-

lating in proximity to the sea; that on these impressible materials, most probably an ancient sea shore, rains pattered, tides rolled, quadrupeds crawled, fishes perished, and birds walked.

This slab of blueish rock, secured by a wooden case, is one of two, purchased recently for the Cabinet of the So. Ca. College, of Krantz & Co. German vendors of fossils. It is a portion of the Lias limestone, a well known rock, which is very extensively developed in Europe. It rises into elevated hills, and even forms an important part of the Jura Alps.— This slab contains an almost perfect skeleton of an extinct Saurian, *Ichthyosaurus communis*. The creature had the snout of a porpoise, the teeth of a crocodile, the back bone of a fish, the paddles of a whale, and the breast bone of a quadruped. No living animal combines all these characters.— The genus, including at least ten known species, the individuals of which were very numerous, perished wholly, long ere the slow deposition began on the Lias of more recent strata, which are 5000 feet thick, and which are seen in the Alps, resting on the lias, (that great charnel house of the bones of these creatures, and those of their numerous congeners, some of which, the flying lizards, were still more strange and anomalous in structure.) In this same slab are remains of Belemnites, marine animals, similar to the existing cuttle-fish. With these were associated extinct animals, (Ammonites,) similar to the recent Nautilus, of which my private collection contains specimens of more than 70 species; and, also, the remains of plants similar to those of low islands within the tropics, but much larger.

Such an assemblage of marine animals and terrestrial plants, all ultra-tropical in type, and strange in structure, cannot now be found on the earth, not even on the shores of New Holland. And, here, permit the remark, that one of the most graphic, thrilling paintings of the age, is reduced in the frontispiece to Richardson's Geology. The original is from the pencil of Miss Plowman, representing the restoration of a scene in Europe, during the deposition of the Lias, the Saurian Age of Geologists. In reference to this period, the Rev'd. Dr. Buckland felicitously remarks: "With flocks of such creatures flying in the air, and shoals of no less mon-

strous 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 those early periods of our infant world." Not a trace of man, or of any existing animal or plant, has ever been found in any of the strata to which I have referred.

I might fill volumes with similar illustrations, taken from specimens in my own collection. From the combined, concurrent evidence of all such cases, recorded in hundreds of volumes, written by intellects of the highest order, we reach, in the language of Cuvier, "another age of the world;" or, in the words of Richardson, such facts unfold "the truth, that the present condition of the earth, far from being of primeval date and character, as is not unfrequently supposed, constitutes but one of the numerous vicissitudes, through which it has passed, in the course of its eventful history." And "these are but a few of the numerous instances, which might be adduced, of the valuable and instructive discipline of a science, which rids us of our errors and prejudices, derived from early habit and association, and implants in their stead more just and philosophical ideas of nature, and her Divine Author."

Hence, though this noble science often startles us by the novelty and grandeur of its teachings; yet, its influence, in enlarging our minds, and in elevating our conceptions of Divine wisdom, power, and benevolence, is precisely similar to that of astronomy, which has caused the opinion of man, with regard to many natural phenomena, as well as with regard to the form, size, and motions of this our little orb, to be wholly changed.

Geology relates chiefly to the past history of the earth.— By incontrovertible evidence, drawn from obvious physical facts, legitimately impressed in endless numbers, on various regularly stratified series of rocks, divisible into at least forty distinct periods or formations, and making in the aggregate more than eight miles in perpendicular thickness, it transports us back to periods so remote, changes so vast, and states of animate existence so widely different from each other, and from the present races of beings, as to conflict with all our



preconceived ideas of the unchanging stability of the earth. Every student of its facts—every investigator of its truths—is soon forced, either to abandon the study, or to admit the conclusiveness of the evidence, which proves that, though man, with the animals and plants associated with him, was created, certainly not more than 6000 years ago; yet, the planet, ages anterior to the human era, swarmed with successive creations of living existences.

This position is true, if evidence can prove any truth. All geologists, without exception, believe it; at least, a geologist capable of doubting it would be regarded, now, as quite as great a phenomenon among naturalists, as was Mr. Kirby, a few years ago, when, in attempting to defend a false position, in despite of geological facts, he avowed his belief in the existence of a "subterranean world of reptiles, where the Iguanodon still flourishes."

Now Mantell, with the concurrence and admiration of all men of science, had proved the extinction of that animal, before the chalk hills of England and France were deposited in a deep ocean, in proximity to a vast continent, "the country of the Iguanodon."

Now, it is incredible, either that all geologists, tyros and profound philosophers, can be deceived; or that all, consisting chiefly of most respectable members of all classes of society, can be leagued together to deceive others. The universality of their conviction should cause any wise man to re-examine his own opinions, and to study the science, before denouncing the position as either false, or as being an irreconcilable discrepancy between geology and revelation.

Yet, though theological writers have differed widely, for centuries, with regard to the age of the earth, (not as the habitation of man, but as a part of the solar system,) and though all astronomical phenomena tend to prove its antiquity, there still exist a few wise, learned, and most estimable men, whose error consists in assuming, that the common interpretation of the first chapter of Genesis, is the only true interpretation of it, proving, thus, as they believe, that the earth was created, originally, out of nothing, only about six thousand years ago;—there are a few, I say, who denounce geology as incompatible with Scripture.

There was a time, but that time is passed, when it was necessary to defend the science against this imputation. That geology should have been opposed, as hostile to religion, "will be regarded, a century hence, with the same wonder, almost approaching to incredulity, with which we, of the present day, hear of men's having sincerely opposed, on religious grounds, the Copernican system of astronomy, when Galileo's exposition of it was formally anathematized by the Romish Church, and he was immured, for years, in the walls of a dungeon."

Indeed, I announce, without fear of contradiction, that four-fifths of the most learned and pious theologians, of this day, admit unreservedly the antiquity of the earth; and, further, that, while they maintain that the Scriptures are absolute in matters of religious faith, they also admit, with Archbishop Whately, "that Scripture is not the test, by which the conclusions of science are to be tried." "Historical or physical truths may be established by their own proper evidence. A christian *will*, indeed," says the same learned prelate, "feel antecedently a strong persuasion, that conclusions, really inconsistent with the Bible, never *will* be established,—that any theory seemingly at variance with it will be found either deficient in evidence, or else reconcilable with the Scriptures. But it is not a sign of Faith,—on the contrary, it indicates rather a want of faith, or else a culpable indolence, to decline meeting any theorist on his own ground, and to cut short the controversy by an appeal to Scripture."

It is not my purpose, however, to notice, now, in detail, the arguments which prove, that there is not the slightest want of harmony between Revelation and geology. It is sufficient to remark, in passing, that all supposed collisions between the Sacred Scriptures and any of the physical sciences, from the time of Galileo to the present period, have successively vanished; and thereby served to strengthen the christian's faith; that the word of God and sound philosophy, being different parts of one great system of divine truth, no want of harmony can ever be established between them, though incorrect interpretations of the one, or partial misconceptions of the other, may, for a time, seem to produce such a result; and that many learned divines—Chalmers, Smith, Hitchcock,



Buckland, Sedgwick, and others, whose piety cannot be impugned without a manifest breach of charity—having studied geology profoundly, have most eloquently shown its important contributions to both natural and revealed religion. They have shown, also, the kind of information we are to expect from the Bible;—that though every part of it was inspired;—that though its inspired pensmen never violate a principle of physical science; yet, as they were not writing a scientific treatise, they often accommodated their language, when speaking of natural phenomena, to the state of knowledge and the prevalent opinions of their age; and that they were taught what truths to reveal, not the exact words in which the revelations were to be uttered. “Few, if any, now believe that the Scriptures contain revelations of truths distinct from, independent of religion.” And even in regard to religious truth, man was left to study it under the guidance of the Spirit, through an imperfect human vehicle, language; and, therefore, he was not left to the chance of misunderstanding it, through the weakness of erring reason, but was promised the teachings of the Holy Spirit, “to guide him into all truth.”

“After all, says Dr. Buckland, “it should be recollected, that the true question is not respecting the correctness of the Mosaic narrative, but of our interpretation of it.” Does any christian presume that either he or any mere man can be certain of interpreting correctly every part of a Revelation by infinite wisdom? If not—if liable to error, in interpreting any part, why not in regard to the exact signification of the Hebrew words, translated create and day, which were so differently interpreted, by the best Hebrew scholars, long ere geology was known as a science?

“It should be recollected, also, that, in all probability, the object of the Mosaic narrative of creation, (that part, at least, which relates most directly to the antiquity of the human species,) was to state, not when or in what manner, but by whom, the world was made. As the prevailing tendency of men, in those days, was to worship the most glorious objects of nature, namely, the sun, and moon, and stars, it should seem to have been one important point, in the Mosaic account of creation, to guard the Israelites against the polytheism and

idolatry of surrounding nations, by announcing that all these magnificent celestial bodies were no gods, but the works of the Almighty Creator, to whom alone the worship of mankind is due.”

“Between the first creation of the earth,” says the Rev. Prof. Sedgwick, “styled in Genesis, the beginning, and that day in which it pleased God to place man upon it, who shall dare to define the interval! On this question Scripture is silent.” And I may here remark, that all geologists, and a great majority of theologians, now concur in the opinion, that all geological phenomena, anterior to man’s creation, occurred in that undefined period, which Moses was inspired to announce as having preceded the creation of man. There are, however, half a dozen other modes of reconciling the apparent, not real discrepancy between the two subjects.

There is one other supposed discrepancy between geology and Revelation. The common interpretation of the Bible assumes that, before the fall of man, death did not exist among the inferior animals; but geology teaches, as we have seen, that myriads of brute animals certainly died painful deaths, long ere man was created.

This interpretation of Scripture, which obtained before geological phenomena had been investigated, and which arose naturally out of a just sense of the miseries entailed on man by the fall, was based mainly on two verses in Paul’s epistles.

In Romans v. 12, it is written, “Wherefore, as by one *man* sin entered into the world and death by sin;” but the Apostle adds, in the same verse, “and so death passed upon all *men*, for that all have sinned.” There is certainly no reference here to the death of any being but man, as a consequence of sin, especially as the writer, apparently to guard against error, adds immediately, in verse 17, “Therefore, as by the offence of one, *judgment* came upon all *men* to *condemnation*, even so by the righteousness of one, the free gift came upon all *men* unto justification of life.”

The other passage relied on is, if possible, still more plainly limited to man. In I. Cor. xv. 21, the Apostle, near the conclusion of his argument to prove that man’s resurrection is a necessary consequence of that of the Saviour, says, “For since by man came death, by man came also the resurrection

of the dead." Now, obviously a plain, literal translation of this verse requires us to limit both death and resurrection to man—the death of man's body, which is to rise again and live forever, if united to Christ by a living faith.

"The death which God threatened to Adam," says Jeremy Taylor, "and which passed upon his posterity, is not the going out of this world, but the manner of going." For the object, in these passages, is to contrast Adam and Christ, as to their influence on the human race. Hence, many learned and pious men, before geology was known as a science, adopted that interpretation of this portion of Scripture, which limits the death described and its consequences to Adam and his posterity.

But there is another perfectly satisfactory mode of reconciling the apparent discrepancy, even if we admit that all pain and death is the fruit of Adam's fall. It "supposes that God, in view of the certainty of man's transgression, adapted the world beforehand to a fallen creature, who must die. It could not be adapted to both mortal and immortal natures, and since sin and death are probably inseparable, it was fitted to the character of the former. Death, then, was introduced into the world as a prospective result of man's apostasy. In this sense, all the misery, disorder, and suffering, of the present world, are the fruit of human transgressions; or, in the language of Scripture, *"the whole creation groaneth and travaileth together until now."*—Hitchcock.

There is, therefore, not a shadow of discrepancy between geology and revelation. And, for the final and complete reconciliation of an apparent variance, we are indebted, in an equal degree, to the untiring industry of geologists, and to the piety, learning, and acumen of theologians. The former collected and recorded facts, from which they deduced a great system of sublime generalizations, and, among others, that which astronomy and other sciences had long indicated, the great antiquity of the earth. Very soon, Penn, Fairholm, and Comstock, whose writings display great ignorance of physical science on every page, assailed geology as incompatible with Scripture; and a few learned deists, always ready to discredit the Bible, eagerly countenanced the assault. To the honor of the clergy, both in Europe and this country,

be it said, a host of able divines, firmly convinced of the truth of Scripture, and of the falsity of any theory really at variance with it, instead of bringing the Ark of God into the field of battle to fight for them, behaved themselves valiantly, and engaged zealously in the study of geology. They soon confirmed, unanimously, the results of geologists; but they also found ample means of defending Scripture, not against geologists, (for they never assailed the Bible,) but against the errors of the pious and the malice of infidels.

And I warn, solemnly warn, the few sincere, able and learned, but mistaken, friends of truth, who still maintain that the common is the only possible true interpretation of Genesis, and who derive their ideas of geology, not from those who, like Chalmers, Sedgwick, Buckland, Smith, Keith, Faber, and Horsley, have profoundly studied the facts and principles of the science; but from those who, like Penn and Fairholm, assumed and then attempted to prove it to be false—not by disproving its facts—not by invalidating its conclusions, but by irrelevant appeals to the authority of Scripture.—I warn them, I say, that their opposition to the science is unwise and fatally injurious to the cause of truth.

"But," says Archbishop Whately, "till the advocates of Christianity shall have become universally much better acquainted with the true character of their religion, than universally they have ever yet been, we must always expect that every branch of study, every scientific theory that is brought into notice, will be assailed on religious grounds, by those who either have not studied the subject, or who are incompetent judges of it."

This is lamentably true. If the opposers of geology, which is established as firmly, immovably, broadly, as astronomy or chemistry, will labor to convince the young or the ignorant, that either the science or Scripture must be false, they will find it easy to strengthen man's natural propensity to unbelief, and to lead to a consequent rejection of the Bible; for every student of the science, every one who hears a good course of Lectures on it, or who even carefully inspects a single good collection of fossil remains from the various formations, all totally different from each other, and especially from all existing animals and plants, is, if unbiassed by early



education and religious prejudice, as certain to believe the antiquity of the earth, as that the three angles of a triangle are equal to two right angles. On the contrary, convince them that the discrepancy, like that which was once supposed to exist between Revelation and astronomy, is apparent, not real; that the significations of the words, "light, day, create, and death," have, for centuries, been differently explained by such interpreters of Scripture as Dathé, Doederlin, Bush, Milton, Taylor, Horsley, Jameson, Faber and Keith; that Luther separated the first two verses of Genesis from the narrative of man's creation; that a great majority of the best geologists are either able divines or professing christians; and that geology has already supplied more striking illustrations of natural religion than all other sciences put together; and you teach them to respect science and to revere the Scriptures;—to expect to find in both concurring evidence of the power, providence and wisdom of God, and of the truth of his revealed word.

The object of Geology is to ascertain and describe the mineral structure of the earth; the nature of the aggregates, called rocks, that compose its crust; the relative positions of these rocks; the useful or curious minerals found in them; the relics of animals or plants they enclose; the changes they have undergone; the proximate causes by which they were made to assume their present forms and positions; and the agents now incessantly at work, producing other alterations, and causing them gradually and imperceptibly, though on a grand scale, to assume, in the very presence of man, new modes of existence. It examines the action of frosts, rains, and torrents; of rivers, seas, lakes, tides, and oceans; of landslips, icebergs, and avalanches; of winds and tornadoes; of earthquakes and volcanoes; in effecting changes on the earth's surface. The origin of hills and valleys, mountains and caverns, fertile plains and sterile deserts, falls within its domain. Incidentally it takes notice of villages, towns and cities; of works of art, agriculture and commerce; of many of the improvements in science and civilization, and of various races of living beings, from the animalcule to man; since these are all influenced by geological causes, and are affected more or less by geological events, and since they are, in their turn,

made the standard of comparison, in all attempts to read and understand the monumental inscriptions, written by the hand of time, in the inhumed bodies of fossil plants and animals.

And from the consideration of the surface of the earth, this noble science leads the mind, by easy, safe, legitimate inductions, to the profound interior, and makes known its probable condition, the agents by which that condition was produced and is preserved, and the effects of it on the surface, in elevating and submerging continents, in changing the relative level of land and sea, and in giving rise to other phenomena, the contemplation of which overwhelms the imagination.

These remarks, on the nature or sphere of geology, lead us naturally to reflect on the vast amount of knowledge, which a thorough comprehension of the science, in all its ramifications, necessarily requires. Nor is this reflection without its use; for it will teach us the folly of expecting one mind to acquire all the preliminary knowledge, necessary or important in teaching a single science. An acquaintance with geography, physical and civil, is indispensable. The geologist must understand the nature of the chemical elements of matter, their relative affinities, the properties of the compounds they are capable of forming, and the circumstances under which these compounds are liable to form new arrangements. The laws of mechanics, the different kinds of attraction, and the effects of the weight and pressure of both fluids and solids, must be kept constantly in view. A familiar acquaintance with minerals, especially with those species which by their aggregation form rocks, or are abundantly disseminated through the strata of the different formations, is highly important. Every scientific geologist must, therefore, have a competent knowledge of chemistry, mechanical philosophy, and mineralogy. In like manner, the effects of climate and the atmosphere on animals, plants, and mineral substances, demand constant attention; for these effects are not only numerous but important, inasmuch as they supply many valuable and interesting analogies. Nor must the planetary relations of the earth be forgotten; for out of these grow many apt illustrations and forcible elucidations of the principles of geology. The laws of those subtle agents also, which are

known by their potent effects only, namely heat and electricity, must be made the subjects of patient study; for in no other way can we understand the true character of many of the most remarkable phenomena exhibited in the earth's crust. Above all, it is necessary for him, who aims at the distinguished honor of being ranked among the most eminent geologists of his age, to be able to pass in review before him, by the aid of distinct characters, thoroughly understood, the entire organic creation, both ancient and modern; not only the terrestrial marsupials, that in distant ages walked on the earth, the sauroid fishes that ruled in the sea; the reptiles that crawled upon the land, swam in the ocean, or soared in the air; the mollusca that swarmed in the turbulent ocean, or upon its rocky shores; the magnificent plants that beautified each new-born island or continent; the myriads of polypi that elevated their habitations into the materials of stupendous mountains; and the anomalous and gigantic quadrupeds that left their remains in tertiary strata, diluvial gravel, subterranean caverns, or arctic snows; but also the living races that give life, and animation, and beauty to the world; for these are the existing standards of comparison. Hence, he must be thoroughly versed in the principles and details of the natural sciences, conchology, botany and zoology, recent and fossil, as well as anatomy and physiology, human and comparative.

If such be the circle of sciences, preliminary or auxiliary to geology, it may well draw from us, says Dr. Silliman, the desponding exclamation, who then is sufficient for these things? We may reply, no unassisted individual. Nor is all this knowledge necessary, even to the scientific geologist, for he may apply to the conchologist or comparative anatomist for aid, when involved in doubts, or perplexed by obscurities. Much less is sufficient for him, whose avocation permits no further acquaintance with the subject, than what will make it a means of passing his leisure moments agreeably and profitably, in contemplating the works of nature.

We are now prepared to perceive the rank which geology ought to hold among the sciences. Its domain being so broad and comprehensive; its objects so vast, diversified and numerous; its facts so novel and unique, and its principles,

even those of an elementary character, so indissolubly linked with those of the other sciences, it may, without exaggeration, be represented as standing side by side with its colossal but fair sister, astronomy, on the great temple formed of all the other human sciences, each presenting equal claims to our admiration; each pointing its votaries, with one hand, to opposite, but boundless fields of research; both pointing their united followers, with the other, to the throne of the great I Am, the author of the harmonious system of eternal truth.

Nor is this claiming undue prominence for the science of geology. Astronomy, it is true, leads the fascinated student of the stupendous works of nature, by natural steps rendered steady and firm by demonstration, through regions of space immense. It teaches him the relations of the parts of the solar system to each other, and of the solar system to other countless orbs of still greater magnitude. It explains to him how, from a diffused nebosity, the sun and its attendant planets, passing, for unknown periods, through various stages of condensation, gradually assumed their present forms, positions, and motions. It instructs him in the arguments which render it probable, that the solar system itself is but an inconsiderable part of a great girdle, formed of solar systems, occupying a position in the less stellar part of the zone. It reveals to him the astounding fact, that our whole visible universe is but an aggregate of suns and worlds, which, to an inhabitant of one of the orbs of those remote regions, that can be seen only by our largest telescopes, must appear as the fixed stars do to us—a mere point of light.

Geology, even here, does not suffer by comparison with astronomy. It conducts us to the invisible universe beneath us, and, as an eminent philosopher has elegantly expressed it, points out to us the *milky way* and the fixed stars of animal life, which the microscope reveals—overpowering us with the contemplation of the minutest as well as the mightiest of the works of creative energy.

It is impossible to convey a just idea of the nature of the discoveries of Ehrenberg, Lonsdale, Bayley, and others, in the *milky way* of microscopic fossil animals, without entering into details, which, however interesting to the naturalist, would be improperly introduced here. It is sufficient for my



present purpose to observe that, as all magnitudes must be alike to an infinite Creator, the wonderful revelations of astronomy cannot impress the mind with more exalted conceptions of creative wisdom and power, than the examination of myriads of beings of distinct and complicated forms, constituting whole masses of the hardest rocks, slate, flint, iron ore, semi-opal, noble opal, yet so light, that, in this specimen, 187 millions of their skeletons weigh only one grain, and so minute that 41 thousand millions are crowded into a cubic inch.

And if astronomy suggests the thought that all the brilliant orbs, which garnish the heavens, may be the residences of sentient and happy beings; geology proves to her votaries, wrapt in delightful contemplation of divine benevolence, that this planet has been tenanted by happy beings, through successive cycles, inconceivably long. It shows us, not only that our apartments are warmed, and our cities lighted by coal, from the wreck of mighty forests that covered the primeval valleys; but that our most costly edifices are often built of rocks, cut from mountain masses of the habitations of extinct races of microscopic animals, and that even the chaplet of beauty shines with the very sepulchers, in which myriads of once happy beings are now entombed. Thus, it shows that death has, in process of time, by a provision of infinite benevolence, become the handmaid and ornament of life.

These remarks bring me to the consideration of the interest of geology. It is a striking peculiarity of this science, that it invests the most common objects with unexpected interest. One, who is unacquainted with its noble processes of inductive reasoning, experiences emotions of sublimity when he views a lofty mountain, a yawning precipice, a stupendous cataract, or a burning volcano; he is pleased with what is beautiful, and surprised by what is new; but he looks in vain for sublimity, novelty, beauty, or any other source of interest, in the shapeless pebble, the rude mass of rock, or bed of clay on which he walks. Let him study geology, however, and it soon becomes to him a talisman, which not only compels the mountain to reveal the secret of its birth, the precipice to tell of its origin in the midst of convulsions, the volcano to disclose the source of its fiery floods, the

cavern to unfold its hidden mysteries, and the rocks to give up their treasures; but converts beds of gravel, sand, and clay, into eloquent and instructive historians of the past, with which he may hold delightful converse, in his most solitary moments.

We all know that ancient history excites deep and peculiar interest. All are aware that philosophers and antiquaries have toiled much to extend its bounds, by adding to its pages new facts, drawn from the manners, laws, arts, and religion of ancient nations; and that, for this purpose, rusty coins, obscure hieroglyphics, musty records, crumbling monuments, disgusting sepulchres, and cities in ruins, have been ransacked, and made to yield their stores, for the increase of our knowledge of the first races of man. No one can forget the thrilling interest with which he read Stephen's description of Aaron's tomb—none the emotions with which he followed him through the gates, streets, houses, and temples, of the rocky city, Petra.

All these details, however, carry us back a very little way into the recesses of antiquity, before truth and fable become inseparably blended. Here, all researches into the history of man, by human records, must have met an insurmountable barrier, a final limit, in a sea of conjecture, had not the inspired writer taught us man's origin, the consequences of his fall, the early events of his history, the catastrophe of the flood, and the subsequent re-peopling of the globe. The sacred writer, however, records the history of but a single being, comprehending all beyond it in the brief description: "In the beginning God created the Heavens and the Earth."<sup>2</sup>—Here the geologist began his researches, and discovered the earth's early annals, written in symbols, on tablets of stone, incased in the pedestals of the everlasting hills, and preserved by time from the destroying power of the elements, as the only history of its lengthened duration. Gathering up these symbols the geologist formed them into a new alphabet, and constructed a new language, in which thousands of laborers have deciphered, sentence after sentence, the great outlines of these subterranean records. These annals have made all antiquity modern. They have instructed us to regard man as the last tenant of the earth, and his creation as among the



most recent events that have occurred on our planet. They have supplied the theologian with the only correct interpretation of the first page of the sacred Scriptures. They have supplied abundant evidence of past changes and revolutions, attended with the extinction of whole living creations, effected by fire and water; and teach mankind to anticipate that awful day, foretold in Scripture, "when existing races, and gorgeous fabrics of national vanity, shall yield their haughty relics to the sport and desolation of the elements,—when the earth shall melt with fervent heat—when new heavens and a new earth shall replace the ruins of a world."

It is true that, before we can participate in the pleasures of the geologist, or enter with interest his peculiar pursuits, we must learn to read a strange language, of which rocks, shells, and fossils constitute the essential characters. But when this knowledge is once acquired, and the acquisition rewards us for the toil we encounter, it opens to us new views of the economy of nature; enables us to combine the phenomena of past, present, and future times; and teaches us many of the laws, established by the Creator, for controlling the mutations of material things.

Such being its sphere, its interest, and its high rank among the sciences, let us inquire very briefly whether its importance is commensurate with its dignity.

Geology is comparatively a recent science; and when such a subject is presented to us, we are apt to ask the question, 'what is the use of it?' Though, at this day, the diversified employments of civilized man afford so many illustrations of the practical utility of all science, that we may not now be disposed to estimate the value of any branch in dollars and cents; still, we naturally wish to know in what way it can promote our interests.

In any employment, a man's relations to the world are so numerous and intimate, that much of his success depends on his knowing his exact position. This he can best do by ascertaining clearly the leading, characteristic features, political, moral, and scientific, of his age. The influence of these he cannot escape; and if he perceive them clearly, he may make them subservie, instead of disturbing, his interests. How vitally did the late disturbances in Europe affect all classes,

especially, the mercantile and agricultural, even in this remote country; yet, how few saw their relation to the throes and agitations that foretold the storm. In 1819, the connexion between magnetism and electricity was first established. And the consequent study and development of extensive branches of new sciences, formed one distinct scientific characteristic of the past twenty years. Do we not see in the success of Morse—in the extent to which it affected many pursuits and even species of property—the importance of keeping pace with the knowledge of our times, and of being able to turn to account any progress in science?

Now, if this position be true, that it is important to every one to know his position—the peculiar features, political, moral, and scientific of the age in which he lives,—the importance of geology is obvious; for it certainly forms the distinctive feature of this period. Even Herschell admits that it alone is inferior in interest, extent, and grandeur, to Astronomy. Hence, for near half a century, it has received more attention than any other science; and among its devotees is enrolled a long list of minds of rare endowments, as Herschell, Agassiz, Sir Charles Lyell, Sir R. Murchison, Hall, Rogers, Lord Egerton, Von Buch, McCullough, Verneulle, De La Beche, &c. It has received the patronage of all European nations. In all, societies for its cultivation and advancement have been established in the principal cities, and costly national collections have been purchased. In most of them, the mineral character of every square mile has been ascertained, at the public expense, and England has caused her most distant provinces to be explored.

In this country, also, geological researches have been patronised by the National, and by most of the State governments; the wonders of the science form themes of discussion in drawing-rooms of taste and fashion; its principles are taught extensively, thoroughly, in most of our seminaries; and lectures on it are demanded in most of our cities. And such is the eagerness with which information on the subject is sought, in places where its importance is known, that Sir Charles Lyell received \$5000 for twelve lectures, delivered in Boston, on "the extinction of species," though each hearer paid 25 cents only for each lecture. This fact he communi-

cated to me in conversation, a few months afterwards. Who, then, can be willing to continue ignorant of either the known principles and facts of such a science, or of its numerous decided steps, in its rapid progress to perfection? He, who claims to be a well educated gentleman, must find frequent occasions, in really polished society, when neither wit, poetry, nor politics, will avail to conceal his ignorance of a science, which offers to all subjects for conversation so novel, varied, romantic and useful.

Besides, those who will not devote sufficient time to it to comprehend its terms, and to apply its elementary principles, debar themselves the pleasure and profit of perusing a large portion of the most interesting publications, that daily issue from American and European presses. These works abound in exhibitions of exalted genius and pure taste, disciplined reason and comprehensive thought, lucid arrangement and profound learning, elegant diction and classic embellishment. "It is an interesting fact," says Dr. Silliman, "that among the fine writers of our day, several geologists hold a high rank." And Richardson says truly, "that the study, unquestionably, owes much of its popularity and favor, among the most intellectual and influential classes of society, to the genius and the gifts of those, who have made it so peculiarly their study." Nor is this to be wondered at; for geology is, beyond all question, the essence of the poetry and romance of science. The celebrated line of Lord Byron,

"The dust we tread upon was once alive,"

could not have been written, nor can it be felt, by one ignorant of geology; and one of Lyell's gems was penned in noticing this line, when he observes, "the philosopher transcends the poet; for while the one can only utter the vague exclamation, that inanimate matter was once animate, it is the triumph of the other to describe the very form which it assumed, when endowed with all the faculties of existence."

Numerous illustrations of the truth of this triumph over poetry might be given; but I will instance one only of the thousands, with which the writings of geologists are filled. It is Owen's description of the *Mylodon*, a huge extinct quadruped from South America. After depicting most eloquently and graphically its form, structure and habits, all

admirably fitting it for uprooting trees, in search of leaves and tender buds, for food, he represents the monster, (the preliminary process of scratching away the soil from its roots having been completed,) as placing itself on its colossal bony tripod, consisting of enormous posterior extremities and tail, and grasping the trunk with its long, curved fore-claws, till every nerve quivered, in its struggle to prostrate the monarch of the forest. Well might the writer exclaim, "extraordinary must have been the strength and proportions of that tree, which, rocked to and fro, to right and left, in such an embrace, could long withstand the efforts of its ponderous assailant."

Man pursues eagerly what is new or marvellous. Hence, the interest with which young and old read tales, legends, and romances. No science is better suited than geology to supply innocent, ennobling means of gratifying this natural propensity. And Richardson, Trimmer, Mantell, and Hugh Miller, have accomplished the important task of showing, that the beauties of the science, far transcending the "Beauties of Waverley," may be presented in such a familiar form, without divesting them of philosophic dignity, as to supply a source of elegant recreation, in the studies of literary men, and even in the parlors of families. May we not, then, anticipate the time, when these romantic, poetic realities, will supercede, in some degree, demoralizing fictions? Such works, far from vitiating the taste and corrupting the heart, could not fail to exert a wholesome moral and religious influence.

The objection may here arise, in some minds, that but few have either relish or capacity for philosophical pursuits; and that still fewer are capable of the patient application, essential to the successful student of geological phenomena. This objection applies, with equal force, to the study of all science; and it is certainly true, that geology, in a far greater degree than any other, offers fields of research adapted to every capacity. For while some of its phenomena require, for their full comprehension, superior intellectual endowments, and a profound knowledge of the details of other sciences, many of its problems may be solved by any ordinary capacity, and facts of deep interest may be gleaned by any attentive observer. Of this truth, many illustrations might be given;



but I will adduce one only, Hugh Miller, for twenty years a laborer in a quarry. He tells us, that as "a slim, loose-jointed boy, fond of the intangibilities of romance, and of dreaming when broad awake," he began what he supposed to be his life of labor and restraint, "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 course of my first day's employment," says he, "I picked up a nodular mass of blue limestone, and laid it open, by a stroke of the hammer. It contained inside a beautifully finished piece of sculpture. Was there another such curiosity in the whole world?"

In a few days he examined an adjacent spot, "in which the layers into which the beds readily separate are hardly an eighth part of an inch in thickness; and yet, on every layer, there are the impressions of thousands and tens of thousands of the various fossils peculiar to the Lias. We may turn over these wonderful leaves one after another, like the leaves of a herbarium, and find the pictorial records of a former creation on every page,—scallops, gryphites, ammonites and belemnites,—twigs of wood, leaves of plants, cones of the pine, bits of charcoal, and scales of fishes; and, to render their pictorial appearance more striking, though the leaves of this interesting volume are of a deep black, most of the impressions are of a chalky whiteness."

Thus began the humble observer of facts, whose volume on the rocks in which he long labored, is the admiration of geologists. Of this volume entitled "Wanderings in the Old Red Sandstone of Scotland," Ansted says, "it ought to be in the hands of every one, geologist or not, who can appreciate the natural and lively descriptions of a self-taught genius."

The importance of this science to many men of business—to even laborers in quarries, canals, and rail road excavations—as a means of adding to their enjoyments, facilitating their operations, and enlarging their minds—cannot easily be estimated. Hence, the elements of geology are now carefully taught in the schools and academies of those states and nations, in which the common school system of education has been adopted. The Regents of New York employed Pro-

fessor Mather to write an elementary school book for the purpose, and Professor Hall, whose Reports, on the geology and palaeontology of New York, are regarded in Europe as an honor to American science, is now, I believe, preparing a similar text book for schools.

Blackstone's farewell to the muses may suggest to others, that such studies are incompatible with professional pursuits. To these an excellent reply may be made in the language of Mantell, who, while successfully engaged in the practice of medicine, studied geology, made numerous important discoveries, raised himself to the first rank of philosophers, wrote six or eight large volumes, delivered several full courses of lectures, and collected a cabinet of twenty thousand specimens.

Dr. Mantell says, "I may be permitted to adduce my own successful medical career, in proof that the pursuit of science is not incompatible with a deep devotion to professional duties. And I will venture to add, that so far from my known scientific predilections having proved prejudicial to my professional prospects, they have, on the contrary, largely contributed towards my success."

But, a knowledge of geology, so far from being a matter of indifference, is absolutely essential to a thorough comprehension of the causes of disease. The dependence of salubrity of climate on geological position, is now admitted by all learned physicians; and the origin of many diseases has already been traced successfully to particular rocks, and their peculiar mineral contents. Thus, Dr. McCullough, a British Surgeon, and a skilful geologist, proved, by a mass of statistical facts, filling much of an octavo volume, and collected during a long residence in India, that goitre, a loathsome form of glandular enlargement, is caused, in a great majority of cases, neither by snow water, nor by a mountain atmosphere, but by the constant use of the water of springs, flowing from particular, peculiar primitive strata.

Adjacent parts of the same state or nation often differ widely in salubrity; yet, uniformity in the composition of the air, preserved by winds and the rapid diffusion and intermixture of gaseous bodies, has caused the investigation of such differences, by men ignorant of geology, to be attended with in-

superable difficulties. Hence, as the cause of difference is real, the numerous, fruitless speculations about malaria, have obscured the origin of many diseases, and perplexed the honest investigator of their causes. Whatever malaria is, whether noxious effluvia from the earth, poisonous exhalations from the soil, or invisible, countless animalcules from decomposing organic matter, the source of it, and its mode of action, must be, in some way, connected with the rocks that form the crust of the earth; for physicians and geologists agree, that the boundaries of geological formations are so often the limits of particular diseases, that disease cannot be independent of geological phenomena. This branch of the science has not been studied. It opens to the medical profession a wide field of investigation. In it, none but physicians familiar with geology can be successful. Malaria, local disease, peculiarity of climate, are phrases used to conceal ignorance. We may hope that some genius will, ere long, appear, capable of combining all known facts, and of deducing principles applicable, in medical practice, to each geological formation. Geology must, in a higher degree than any other science, save chemistry, perfect the theory of medicine.

The scenery of any country is so uniformly determined by its rocks, that the geologist can generally infer the kinds, ages, and contents of its formations, from the outline and aspect of its mountains, hills, and vales. Ignorance of this connexion between geological characters and natural scenery, has led even modern painters into gross errors, in their pictorial representations of scenes, in known geological localities. It is obviously absurd to invest with the harsh, broken, rugged outlines of primary regions, places known to be in geological positions incompatible with such physical features. Many justly celebrated paintings are palpably faulty in this respect.

If we place a cast in plaster beside the original statue, chiseled from Carrara marble, we perceive, instantly, the degree to which the finest productions of the sculptor are indebted for expression, to the purity, structure, and translucency of the rock used. Observations of such facts are said to have induced Sir Francis Chantrey to make himself so proficient in geology, that he selected faultless materials for

his chisel; while other sculptors, ancient and modern, employed that rock, without reference to its purity and durability, which, fresh from the quarry, seemed beautifully adapted to the purpose. Yet, owing to defects, that would have been readily detected by scientific scrutiny, many of the most exquisitely finished productions of this noble art have, like the Ariadne of Dannaker, been stained and disfigured, by the incessant chemical action of the air, on the minute but energetic impurities of the materials employed. This difference, in the process of decay in rocks, cannot have escaped any traveller in mountain scenery. The surface of some rocks, that are brilliant and beautiful within, is rough, stained, ochreous or sombre, while that of others is bright, smooth, unchanged in color.

Architecture, in a still greater degree than painting and sculpture, and other fine arts, is dependant on geology for the beauty and durability of its structures. This may not seem obvious, in our country, owing to the infrequency of erecting stone edifices. The Capitol at Washington, however, though the finest Senate-house in the world, shows signs, already, of premature dilapidation and disfigurement. The foundations of the old, but very costly, State-House, and also of the College edifices, in Alabama, were laid with a bluish gray sand-stone, which, though beautiful in aspect, when first quarried, would have been condemned by any geologist, because he would have perceived instantly, that the cement, protoxide of iron, must redden, rot, scale, and crumble, when exposed to the action of air, rain, and frost. The buildings are already stained and cracked, and are hastening to ruin. Similar instances in Europe are so common, that the magnitude of the evil has arrested attention; and, after the late destruction by fire of the Houses of Parliament, government appointed a commission, of geologists chiefly, to select, if possible, a perfect material for the new edifices. After a scientific survey of the rocks and quarries of the Island, the commission recommended, in a most able report, a member of the magnesian limestone, previously little known beyond the immediate vicinity of the quarry. England has thus borne testimony to the practical utility of geology, in this as in other instances, a detail of which, if time would permit,



would not be out of place, in this attempt to demonstrate the practical utility of the science.

At this period, when the world is being intersected by railroads, traversing every variety of geological site and structure, and costing vast sums, a familiar acquaintance with this science is universally regarded as an essential qualification of an engineer; and it is made an indispensable part of his education. In choosing sites, avoiding obstacles, raising embankments, cutting tunnels, locating bridges, constructing culverts, and selecting materials for masonry, it furnishes him the best means of escaping errors, heretofore not uncommon, fatal to his reputation, and to the security and stability of the enterprise.

It is unnecessary to dwell on the admitted relations of geology to mining, whether the object be to search for or obtain coal, metallic ores, or precious gems. I may remark, however, that as the science has ascertained, in most cases, the exact position in which each valuable mineral substance occurs, its utility to miners is chiefly exercised in discouraging and preventing expensive, ruinous searches for particular minerals, in situations in which they cannot be sought with the remotest prospect of success. To South Carolina, especially, in giving a wise direction to her infant manufactures, how momentous the fact that coal, more valuable to a manufacturing and commercial community than gold, cannot be found, at least in workable beds, in any part of her territory. This fact must exert a controlling influence on her laws, her policy, and prosperity, and should teach her to avoid some and encourage other investments.

The success of the agriculturist must ever depend mainly on industry, economy, and skilful cultivation. Science can direct and aid him in the exercise of these; but, without them, its teachings are of little avail. Still, no one can doubt that, in ascertaining the nature and capabilities of his soil, in draining his land, and especially in manuring, he may derive most valuable assistance from geology. The great defect in agricultural papers, journals, and reports of societies, is the indefinite language in which writers describe their experiments and modes of tillage. The only remedy for this defect is, I apprehend, the uniform use of technical, scientific

terms, understood by all in the same sense. Now, as every soil is disintegrated rock; as all rocks have been arranged in classes, systems and formations, which are essentially the same all over the world; as the names and relative positions of these formations can easily be learned; and as the chemical composition of each varies but little, generally, in different distant localities, (the Burhstone, or green-sand, or cocene marl of Alabama, being strikingly similar to that of Georgia or South Carolina,) great advantage would manifestly result to agriculturists, should they agree to use the precise terms of geological science in describing their soils, and in communicating to others the results of their experiments. It is certain that, so long as they neglect the study of geology and chemistry, the best established and most comprehensive principles of this noble science, will be regarded by most of those, whose interests it is calculated to promote, as ingenious speculations and dangerous theories, because those principles are not understood or are misapplied. Precisely as when, ten years ago, an ignorant physician, who wished to use exhilarating gas (protoxide of nitrogen,) in an urgent case of tetanus, wrote to me to prepare sulphuretted hydrogen, to be inhaled by his patient. The gas was prepared, but the patient was warned that its administration would certainly be fatal. The quack prevailed, and the sufferer died.

The relation of national prosperity to geological positions has been ably shown by several learned writers. Dr. Buckland has proved that, in England, particular national pursuits are confined to peculiar geological positions, and that nineteen of the largest cities in that Empire, from Carlisle to Exeter, are all located on the line of one formation, which contains within it rock salt and gypsum, and under it, in close proximity, the great deposits of coal, iron and limestone, which add incentive, supply, and wealth, to the enterprising population of a favored region. Indeed, so deeply has the geological structure of every country impressed itself, in all ages, on the pursuits, manners, morals, and laws of nations, ancient and modern, that an outline of the principles of geology, with an accurate geological map of the world, will, ere long, be regarded essential prerequisites to students of history, jurisprudence, and civil polity.



Geology has given a fresh impulse to several other sciences, by furnishing numerous facts illustrative of their principles. Thus, botanists and zoologists had observed many chasms in existing races of animals and plants. The chains or series, in many instances, seemed broken, proximate genera being widely separated, without any apparent connecting links. Extinct genera and species already fill these blanks in numerous instances, thereby enhancing the value and interest of those sciences. So extensive and important have been these contributions to zoology and botany, and especially to comparative anatomy and physiology, that the ablest naturalist in the world, Agassiz, has avowed his conviction, that a perfect classification of animals and plants can never be attained, without combining the principles of fossil geology with those of botany, zoology, and comparative physiology.

"Indeed," says an elegant writer, "the noblest and highest advantages to be gained from this instructive study, consist not in considerations of benefit or of detriment, of profit or of loss, for these we might pursue to a much greater extent, but in the intellectual advancement and moral improvement, which it is so well calculated to promote, and in its power of invigorating the mind, and purifying and chastening the feelings and the heart. If as, who indeed can doubt, the celebrated aphorism of Lord Bacon be true; and if all study, as he affirms, is to be valued, not so much as an exercise of the intellect, but as a discipline of humanity; in other words, not in proportion as it may render us more clever and more acute than others, who possibly may not have enjoyed the same advantages with ourselves, but as it makes us better as well as wiser, and advances us in the scale of moral as well as intellectual being; what study can be more instructive and refining than that which, by teaching us to look into the beautiful and harmonious world around us, corrects and chastens our overweening opinions of ourselves, removes and dispels our inadequate ideas of nature, and substitutes more just, because more magnificent, views of the grandeur of creation, and the perfections of its great and infinite Author. The studious and the observant, the moralist and the divine, may deduce from its varied contemplations, lessons of the highest wisdom; and the immortal English

bard, who has depicted almost every condition of human life, might seem to have had the modern geologist in view, and to have described, with prophetic anticipation, his secluded, but useful existence, and his unobtrusive, but beneficial occupation, in the well known passage," which is often cited by those, who do not feel its import:

"And this our life, exempt from public haud,  
Finds tongues in trees, books in the running brooks,  
Sermons in stones, and good in every thing."

Is he not described accurately by Mrs. Hemans, as one,

"Who, by some secret gift of soul or eye,  
In every spot beneath the shining sun,  
Sees where the springs of living waters lie."

Finally, geology strengthens the christian's faith by showing coincidences between physical science and Revelation, on points where we might reasonably expect discrepancy, if both were not true. Both teach us that changes on the globe are produced by water and fire; that existing continents were once covered by the ocean; that by Almighty power, the waters were collected into seas, and dry land made to appear; that the work of creation was progressive; and that existing races of animals and plants, with man at their head, were brought into being at a comparatively recent period; certainly not much more than 6000 years ago.

And it is a remarkable truth, worthy of being solemnly considered by skeptics, that no principle of geology is more firmly established than that which is revealed in the first verses of the Bible, "In the beginning, God created the heavens and the earth, and the earth was without form and void."

By process of reasoning, conclusive as any mathematical demonstration, the student of nature, on any part of the earth's surface, is led from superficial beds of alluvial strata, containing the remains of man and his works of art, through successive descending series of rocks, sometimes ten miles thick, filled with the relics of extinct animals and plants, departing more and more widely from living beings, as he descends lower in the series, till he reaches the primary, metamorphic beds, which contain not a trace of organic existence, and which bear upon their faces and contain within themselves evidence of having originated in a period of fusion and convulsive chaos. The earth, even according to

science, had a beginning in chaos—was without form and void.

And of the millions of myriads of individual animals and plants, belonging to at least 20,000 extinct species, pertaining to five successive creations, and extending through periods inconceivably long, but of which, as we have seen, geology shows us the beginning, not one has ever been found, which may not be referred by naturalists to some existing genus, order, or class, of animals or plants. Now, it is well known, that classes, orders, genera, and species of organic beings, to which Omnipotence only could impart life, are not arbitrary systems of scientific men; but that they are real expressions of a great system of principles, according to which existing races were created. Hence, according to all rules of correct reasoning, such unity in the plan of extinct and living beings, preserved often in the minutest details of structure of countless existences of succeeding cycles, must be ascribed to unity of cause, to one designing Being—infinite, eternal and unchangeable, in all his attributes.

I have endeavored, this evening, to illustrate the necessity of renouncing the influence of prejudice and preconceived opinions, when we engage in the study of physical science; and to shew that, instead of discrepancy, there is real harmony between geology and Revelation.

I have attempted, also, to explain succinctly the nature of geology, by defining its object, ascertaining the sphere of its investigations, tracing its scientific relations and dependencies, and evincing its claim to a high rank among the branches of physics.

Lastly, I have aimed to prove its importance, by shewing that as, for near half a century, it has engrossed the attention of governments, communities, and philosophers, more than any other part of human learning, constituting the great, peculiar scientific characteristic of the age, no one wholly ignorant of it can fully perceive the spirit of his times, and his own true position; that geological writings embrace a large portion of European and American literature; that as geology is full of poetry and romance, it gratifies the desire of young and old for the marvellous, without vitiating the taste, or corrupting the heart; that it affords fields of research

adapted to every capacity; that its pursuit, far from being incompatible with professional success, is essential to the discovery and comprehension of all the causes of diversity of climate, and the local prevalence of peculiar diseases; that it affords important aid to painters, sculptors, architects, and other lovers of the fine arts; that it forms an indispensable element in the education of skillful engineers, miners, and intelligent agriculturists; that it is eminently useful to historians, jurists and civilians; that it has developed principles, which must form the basis of all future attempts to remodel and improve the systems of classification in Natural History; that it enlivens the imagination, strengthens the understanding, calms turbulent emotions, and refines and humanizes the soul; that it brings with it its own peculiar rich reward, placing us in delightful communication with nature in all her retreats, whether in rugged mountains, desert wastes, or fertile plains; that it has yielded most forcible illustrations of natural theology; that it has confounded infidelity, and strengthened the christian's faith, by supplying wonderful coincidences between scientific and revealed truth;—above all, that it has proved conclusively, by incontrovertible arguments, drawn from the everlasting hills, the inspiration of the first verses in the word of God!