MEMOIR

OF

EDWARD HITCHCOCK.

1793–1864.

BY

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BIOGRAPHICAL MEMOIR OF EDWARD HITCHCOCK.

We cherish the memory of the good and wise, not because they are rare, for the world is full of them; they exist in every society and grade of society, in every business and profession, even in the limited circle of acquaintanceship of every respectable person. But we cherish the memory of the wise and good, because it is dear to us, because we have been taught, encouraged, aided, cheered, blessed, and ennobled by them; and their memory is a continuation of their living words and deeds, and we can make it an heirloom for our children. A man to be remembered is a man to be spoken of. Even in the most barbarous aboriginal stages of the history of mankind, men here and there appeared, whose biographies, could they be written, the world could make good use of. In our own days of high civilization, almost every active life deserves a record. But the law of natural selection rules in literature also, and the struggle for posthumous fame, like the struggle for animal life, is crowned only in the persons of the best competitors. One of these favored few we celebrate this evening.

A man of religion, a man of science; in both, a docile student and an expert teacher; in both, enthusiastic and self-sacrificing; in both, gentle, persuasive, affectionate, sympathetic; in both, shackled by traditions which he both feared and hated to break, yet vigorously holding up his shackles and keeping abreast and in some respects ahead of the advancing age.

Such was Edward Hitchcock, one of the fathers of American Geology, and one who continued to the close of a long life to be an original investigator. A man of ardent fancy, impulsive, curious, and credulous; docile and teachable beyond any adult man of science I ever knew; modest to a marvel; yet, with all this, a man of sufficient self-reliance and determination for the

most important practices of life, patient of difficulties, persevering and industrious for final success in any undertaking, sound in judgment, and disciplined in temper, a friend to all, and the friend of all, his whole career laid claims to eminence, which would have been pre-eminence in American Theology, had it not been for the interference of his science, or in American Science, had it not been for his devotion to the ecclesiastical and financial interests of the College, which he saved from premature decay, and refounded upon the deliberate sacrifice of his own ambition.

Edward Hitchcock was born in 1793. His father was a small farmer who had learned the trade of a hatter, had fought in the Revolutionary War, and was a deacon in a Congregational Church, a man of strong mind and steadfast piety, a genuine New England Puritan.

His mother was a high-bred New England woman, one of those perfect creations of divine skill by which the development of our race is guaranteed; a woman of quick intelligence, pure heart, and exquisite sensibility. The son was therefore born both to religion and to science. The keys of the spiritual and of the physical worlds were hid beneath his pillow. He heard told every morning the tremendous dreams of the Church, and became a poet. The Unitarian controversy made him a thinker. The Comet of 1811 made him an observer. Step by step his imagination and his understanding were unfolded, alternately and together; and neither at the expense of the other. The times were propitious. The nineteenth century opened when he was but eight years old, the age when the brain is fully formed and fit to begin its work. The harvests of New England are neither corn nor wine nor oil, but self-reliance and independence, economy and energy, intelligence, high aspirations, the power to learn and the right to teach, insight into the worth of ideas, and a scorn of facts which do not submit to universal laws, a curiosity bounded only by the limits of the possible, and a veneration for man as man; the master, not the slave, of circumstance. These were the influential forces which worked around our young philosopher and poet, educating him to become the intellectual teacher of his village (Deerfield) at the age of twenty-two, the religious teacher of the church at Conway at the age of twenty-seven, Professor of Chemistry and Natural History at Amherst at the age of thirty-two, chief of the Geological Survey of Massachusetts

at the age of thirty-seven, Doctor of Laws from Harvard, and representative of American Science as first President of the American Association for the Advancement of Science at the age of forty-seven. At fifty-one he represented both science and religion as President of Amherst College, and continued to be thus one of the foremost men of his age for twenty years longer, until his death in 1864. A venerable life!

There is something not a little awful in exploring the domains of a life that is not ours. It is a labyrinth illuminated with the faintest twilight; a group of caverns to be surveyed with ropes and torches, haunted by romance, and stocked with images to which the excited imagination of each spectator gives some different shape. The principles, the motives, of another man's soul are to me underground rivers, flowing in undiscernible abysses; and his thoughts flash before my eyes like Protei in the waters of the cavern at Adelsberg. What can I know of their birth, or of their true shapes and natures? I can see that many of them are blind; but I must argue that they are all well fitted for their native home. The good and the bad, the wise and the foolish, all add alike to the beauty of the entire universe. The biographical critic therefore runs a thousand risks, either of impertinently maligning the creature, or of presumptuously arraigning the Creator. Neither is all gold that glitters; and the biographer must not expect to be believed when he returns to the daylight of crowded life and describes his Wier's Cave as filled with exquisite carved statues of Washington, or the glittering crystals in the roof of his Mammoth Cave as equalling, in their brilliancy, number, and effect upon the senses, the stars in a tropical sky. Too much sensational biography has been allowed. Individual souls are worth no more to the race than individual soldiers to an army. Even in camp the waste is ten per cent. But the moment the army moves, the waste becomes thirty per cent. and forty per cent. Such is the waste of souls in time of spiritual excitement, in revivals of literature or religion, and in the periodical advancements of national politics towards a perfect socialism. Yet the histories of nations lost, and the biographies of souls wasted, deserve better to be written, because fuller of adventure, and therefore of instruction, than those of Rome and Cæsar. But the muse of history can only write in presence of its monuments. What botanist could succeed, were he to

study only the fallen trunks and macerated leaves of the forest? The monuments of a life are its only guaranty of immortality; dim, mystical, and fragmentary though the hieroglyphics be from which they that come after are to make out the complexity and grandeur of the character of him who has gone before.

The man whose eulogy we read to-night has left us monuments enough. They stand in long lines above his resting-place, like the Menhirs of Carnac, vistas of monoliths. Some men are satisfied if they erect but one, like that which now lies broken into four fragments at Loc-Maria-Ker in Brittany, along the ground. The intellectual energy of other men survives in some Druid circle sacred to a single deity. But Edward Hitchcock lived a various life, and wrote of all that touched the deepest consciousness of his age. His monuments stand in parallel ranges. In Religion he wrote five volumes and thirty-seven essays, pamphlets, and tracts. In Science he published fourteen volumes, five pamphlets, and seventy scientific papers, on Botanical, Mineralogical, and Geological and Physical subjects, in journals and reviews. His works on Temperance are in three volumes and three smaller tracts. In early life he wrote a tragedy, the year the great Napoleon fell. And there are twenty-six titles given us of various other productions of his pen, which went to swell the current published literature of the times in which he lived. Other men write as much, and publish nothing. But who counts the half-cut stone still lying in the quarry as among the obelisks of Egypt? This man lived for his times, not for himself. He was no *dilettante*. The perfume of the flowering of his soul was not wasted on the desert air. He was no anchorite, but a true missionary both in religion and in science. He was not fond of that *dolce far niente* which confined the delights of the Decameron to a select circle of ladies, while the surrounding world was wretchedly perishing with the plague. He did not sympathize with the proud reticence of men of science who claim that the doctrine is esoteric; that to popularize science, degrades it. What he learned, he communicated, like an apostle. And if, like an apostle, his zeal led him to act or teach an error, he was ready afterwards, like an honest man, to make his recantation, and advance the general intelligence in that way also. But he was saved from making great or many errors by the patience and precision with which he worked.

The best illustration of his precision is afforded by the history of his controversy with Mr. Blunt, the republisher of the Nautical Almanac in New York. In 1811 young Hitchcock had used the telescope of Deerfield Academy for observing the comet. "The subsequent winter," he says, "was in good measure devoted to a reduction of his observations, and, as he had access to few books, he was obliged to calculate by spherical trigonometry many elements which, at this day, are found in the tables of practical astronomy. The mere effort to form an accurate idea of the numerous spherical triangles he had to construct was an admirable discipline, and their accurate solution not less so." In making these calculations he was obliged to use Blunt's Almanac, on the opening monthly page of which this challenge was ostentatiously printed: "Ten dollars will be paid on the discovery of an error in the figures." The young astronomer amused himself by collecting such errors, and mailed his collection to New York. In spite of the placard their value was unrecognized. He then published the list in the American Monthly Magazine. Blunt's ire was roused; he hastened to explain that, although "one Edward Hitchcock had made the discovery of some few errors in the astronomical portions of his Almanac, the portion devoted to the practical use of sailors would be found to be perfectly reliable, and was a thousand times more important." The young astronomer was soon ready with another list, taken this time from the tables of lunar distances, practical enough on shipboard. The publication of these twenty errors, and of thirty-five more six months later, were his only reply to the scurrilous attack of Mr. Blunt. True science received its proper reward. The boastful and stupid editor of the Almanac was compelled by public opinion to employ a competent person to recalculate the Almanac for 1819, and advertised the enlargement of his own ideas by prefacing in the new edition these more modest words: "It will afford much satisfaction and promote commercial advantages, if, on discovery of an error in any nautical work, publicity should immediately be given." No allusion, however, to "one Edward Hitchcock"—merely a presentation copy, in which thirty-five new errors were immediately discovered, announced, and acknowledged humbly by the editor. There is no estimating the value of such a bit of scientific history. When the young mountain poet of Israel encountered the giant Goliath of Gath, a slip of that young foot

upon the rock, a quiver of the eyelid, would have changed the stream of history through all ages, and postponed the coming of Christ to save the world. But to the young poet himself, the prosperous issue of the adventure was more than the salvation of a world; for it made him the right arm of Israel, and the tongue of Christendom. The same law of the mutual intersubordination of the whole to the part, and of the part to the whole, however denied by the school of Buckle, holds good under all the disguises of modern socialisms. The young Hitchcock, in a moment of idle fancy, with the daring of a fresh observer who had never yet been punished for making a mistake, attacked one of the established institutions of the world, and, by his courage, clear sight, patience, and good nature, introduced a practical reform which was felt on every ocean round the world, and, at the same time, lifted himself to the platform occupied by recognized and experienced men of science, where he continued to observe with the same patient precision, and publish with the same courage all he knew.

He says in his autobiography, reviewing the list of his publications, that it seemed as if he had written and published too much—that, had he spent more time in preparing his productions, their literary execution would have been more creditable, and the thoughts more mature and effective; but the peculiar circumstances of his early life compelled him to a course which, probably, he adds, "were I to live my life over again, I should pursue essentially the same" But the subjects on which he wrote were novel, requiring original research, and the descriptions of them scientific accuracy rather than literary elegance. This is his self-excuse, gratuitous and unnecessary; for the style, especially of his later works, is sufficiently scholarly, and the order, as well as the expression, of his thoughts, lucid and complete.

This, however, is no place for the reading of a critical review of his geological or of his religious works. I can only group them in such a way before your imagination as to paint the foreground, the background, and the middle distance of his soul's life. In the foreground, the terraces of the Connecticut and Deerfield valleys, the fossil footprints on the quarries of Hadley, and the flattened pebbles of the gneiss; the middle distance full of the local geology of Massachusetts and Vermont, Martha's Vineyard, Portland and its vicinity, Texas, Western Asia, and

the world at large, with a thousand physical and social subjects, all interesting to his active, serious, and affectionate mind; and in the background, Alps on Alps of sacred dogma and religious aspiration, with glaciers interspersed of cosmic speculations, and deeper vales of self-consecration, self-sacrifice, and beneficence, bearing their harvests of good fruit.

In the foreground of every life, distinguished from the common life of the crowd, lies some object characteristic and nominative, the seal and signature of that man's dæmon, by which he shall be recognized and spoken of forever. The print of a bird's foot on a slab of red sandstone is the *totem* of Edward Hitchcock. He was not the first to see these wonderful remains, nor even the first to see them with an eye of trained judicial and executive science. But though others built and owned the city, he carried off its gates upon his shoulders. His patience in examining these remains; his economical skill in collecting them; the taste and largeness of mind which he displayed in their arrangement, and the energy with which he pursued this new branch of Palæontology, until the world recognized its claims and learned its merits, entitle him to rank, at least, as the coequal of its true discoverer. Dr. Dean early convinced himself, and Dr. Hitchcock afterwards, that the vestiges were those of living creatures, birds wading on the estuary flats; and both together convinced the world of it. But, besides this, there was much more to do. Specific differences were to be determined. He, Hitchcock, determined one hundred and twenty species. Comparison with foreign specimens was indispensable. He made the finest cabinet in the world, and placed it at the disposal of students. He published plates and descriptions of its contents, so that geologists in other countries might discuss opinions. He exerted such an influence over the public mind that the State of Massachusetts became the publisher of the new department. No controversies will ever avail to divorce the name of Edward Hitchcock from that of Ornithichnology. His name has become itself an imprint —not a bird-track, but a bard-track—upon the rock. Sedgwick and the Cambrians, Murchison and the Silurians, Hugh Miller and the Devonians, Rogers and the Appalachians, Lyell and the Tertiaries, are not more household terms in the history of our science, than is "Hitchcock and the New Red Sandstone" of the Connecticut River Valley, with its beautiful trap ranges, Mount

Tom, Mount Holyoke, and the rest of them; and its Robinson Crusoe footsteps in the sand of an age so ancient that the silence of the dawn of an eternity seems brooding in it; broken only by the weird cries of these birds, or the horrid croaking of batrachians huge as our pachyderms, among whom they fed. This ancient mystery reminds one of the horrid stories of the haunted house of Pottsville, where the inmates would be sitting at their work, the doors would fly open, sighings would pass along the air, footsteps would be seen pressed into the soft plush of the carpet, but not a form possessing the solidity and heaviness of life could be once observed. Although the majority of these vestiges seem to have belonged to quadrupeds, yet a few of them were probably the tracks of bipeds; and even if these bipeds shall turn out to be reptilian in their principal features, and to belong to some synthetic type, like that expressed by the Solenhofen archæopteryx, the term "bird-track" will continue to be used for all of a trifid form, and Hitchcock will remain the great expounder of the difference.

His first account of them dates back thirty years. In 1836 he published his first description of the Footmarks of Birds (Ornithichnites) on the New Red Sandstone of Massachusetts, in the twenty-ninth volume of Silliman's Journal. He followed it up with a description of those found in Connecticut in the thirty-first volume; a general table of fossil footsteps in sandstone and graywacke in the thirty-second volume; five new species in the first volume of the Transactions of the American Association; still new species, with descriptions of coprolites, in the forty-seventh volume of the Journal; and an analysis of the coprolites in the forty-eighth volume. He described two more species in the fourth volume of the new series of the Journal, still more in the twenty-first volume. His first quarto volume on the Fossil Footmarks of the United States, from the Transactions of the American Academy, appeared in 1848, and additional facts respecting the Otozoum Moodii in the Proceedings of the Association for 1855. His quarto report on the Ichnology of New England appeared in 1858, with further remarks, in the Proceedings of the Association for 1860, and new facts and conclusions in the Journal for 1863. These are his monuments. Most men would consider them sufficient for one life. In his they merely mark an episode; but there were others: an episode only of his scientific life. I

leave the notice of it here, with the remark that he worked in it almost alone, and that he has left it standing unaltered by the labors of others. His publications on this theme are not only classical, but standard. His determinations are of accepted authority, which no controversial doubts as yet obscure. I pass now to others of which this cannot be said—in which he has been a disciple rather than a master—and which are rather characteristic of the genius of the geologist, than influential in the progress of geology.

I refer first to the study of the Drift. In Structural Geology this is the great question of the day. The subject has extraordinary difficulties. Could we determine the cause of the drift deposits, it would explain much that is puzzling in all the formations, down to the very base of the Laurentian. The wildest speculations meet at this point of Geology. It is the horse-latitudes of the voyage. Forty years ago the Swiss geologists shocked the world with the announcement that all the giant blocks of primary rock which travellers see lying stranded halfway up the Jura had been carried thither by a forward expansion of the glaciers of the Alps, invading, oversliding, and deeply burying the entire plains of Switzerland. Twenty years ago Mr. Agassiz, having previously shown the Scotch and Welsh geologists the traces of a similar universal glacier, which once descended from their highlands and covered all Great Britain, appeared upon this side of the Atlantic to establish among us the grand mythology of universal ice. From Halifax to the Fond-du-lac, and from the Ottawa to the Ohio, he found its vestiges. And now he covers with it the entire water-plains of the Amazons, the Orinoco, and the La Plata, from the shores of the Andes to the sea, six millions of square miles of the earth's surface, a part of it directly under the equator and close upon the level of the sea.

But we are concerned, not with the truth of these ideas, but only with their introduction into America, and their partial adoption by Edward Hitchcock, towards the close of his life. I say their *partial* adoption, for in the discussions which ensued he exhibited his usual mixture of conservatism and love of new ideas. He was, as a man, both timid and adventurous. Adventurous and progressive where he thought he could see his way; hesitating and submissive to authority when himself in the dark.

And this composition of adverse habits, held in balance by circumstances, not by will nor by genius, made him a representative man—a geologist in whose writings one can read the halting progress of American Geology—its ignorance of its own past history, its premature intuitions, its ill-bred waywardness and levity, its abortive investigations, its double-minded instability, its feeble conservatism, its energetic radicalism, the fertility of its fancy, and the haziness of its judgment, its patience to wait, and its power to work, for what it is as ready to abandon in a moment for something new.

The subject of Surface Geology, involving, of course, the question of the Drift, early claimed his attention, for his Geology of the Connecticut was published in 1823, after it had appeared as an article in the very first volume of Silliman's Journal, one year previous to Eaton's first report on the Geology of the Erie Canal, and Olmsted's first report of the Geological State Survey of North Carolina. At that time the only recognized agency to which the drift phenomena could be ascribed, was that of moving waters. Deltas, terraces, drift boulders, and polished rock-surfaces were all explained in a vague and poetical way by diluvial floods. The grandeur of the phenomena was not appreciated, but their nature was. When, ten years afterwards, the brothers Rogers got the first true glimpse of Appalachian erosion in its immensity of breadth and height, the aqueous theory swelled to commensurate proportions, just as the ice theory has grown to suit the geographical development of the drift appearances.

Had Dr. Hitchcock been more of a poet, and less of a Yankee, he would have adopted an hypothesis similar to that of the Rogerses, and been hampered by it all his life. But he soon detected traces of another agency, and although the absence of Alpine summits from New England, and the distance at which the northern icebergs melted from its coasts, deprived him of opportunities for coming to a lively consciousness of his suspicions, they prepared him to accept the first instructions on the subject which were sent to him from abroad. He always maintained that he got his first clear views of the joint action of ice and water from the researches of Sir James Hall, although Murchison, in his anniversary address before the London Geological Society in 1842, accords the honor of inventing the glacio-aqueous theory, as Hitchcock named it, to Peter Dobson, of Vernon, in

Connecticut, whose first public communication on the subject appeared in the tenth volume of Silliman's Journal, in 1826, and whose letter to Dr. Hitchcock, in 1837, the latter never answered, but kept for six years among his papers, and only sent it for publication in the Journal in 1843, the year following that of Murchison's public indorsement of Mr. Dobson's views, as "a short, clear, and modest statement of the best glacial theory—the essence of the modified glacial theory at which geologists (says Murchison) have arrived after so much debate." Mr. Dobson described certain red sandstone boulders, too angular to have been rolled by floods, and scratched upon their inner sides, "as having been dragged over rocks and gravelly earth in one steady position;" adding, "I think we cannot account for these appearances unless we call in the aid of ice as well as water, supposing that they have been worn by being suspended, and carried in ice over rocks and earth under water."

These views of Mr. Dobson had been twenty years on record, but neglected, when they were thus quoted and complimented by the highest authority in Great Britain. It was at one of those epochs of excitement which occur periodically in the history of every science. Agassiz had appeared at Edinburgh; and for him to come was to see and conquer. Neither Murchison nor Lyell at that time accepted his glacial hypothesis in its broad applications to the circumpolar earth and the entire drift. But from that day onward the younger geologists, with Ramsay at their head, worked at it *con amore*, and strengthened its claims to acceptation by annual fresh discoveries; but they have finished by assigning to it such incredible omnipotence, and claiming for it such impossible activity, as its great master has never authorized. So that its reputation has been seriously compromised, and, as was inevitable, a reaction has set in. Our business hereafter will rather be to shield the glacial theory from undue disparagement than to complain of its extravagancies.

Dr. Hitchcock, with the enthusiasm of his nature, had at first expressed himself too favorably of this hypothesis. He retracted his expressions when called to account for them by Murchison. In an article which he sent to Silliman's Journal, July 5th, 1842, he insists that Murchison, in his Annual Address, ought not to have charged him with being an advocate of Agassiz's ideas in an unmodified form; for, "although the *Études sur les Glaciers*

had, indeed, thrown a flood of light unexpectedly into his path, yet he had always thought, and still thought, that the moraines of America were produced by icebergs, and not by glaciers." "Whatever impression," he writes, "my language has conveyed, I now declare that I have never supposed it possible to apply the glacial theory of Agassiz to this country without modification. I stated [before the Association of Geologists at Boston, in April] my conviction that glacio-aqueous action has been the controlling power in producing the phenomena of drift, by which I mean the joint action of ice and water, without deciding which has exerted the greater influence."

These words give us a clear knowledge of the attitude of his mind in the presence of a discussion which filled the geological world with clamor at that time as it does to-day, and obliged every geologist to define his position. His slow and cautious disposition, disciplined by field work on the one hand, and by college lecturing on the other, restrained his imagination from adopting any large hypothesis, but confined him to a few familiar statements of mere fact. All he knew, or cared to know, or believed that any one would ever know, was, that a sheet of loose sand, gravel, and boulder rocks, bearing certain marks of moving force upon them, covered certain portions of the surface of the earth, and that this sheet had been spread out not wholly through the agency of water. "Whether the vast currents of water which must have been concerned were the result of the sudden melting of the thick belts of ice around the poles, as Agassiz supposes, or of the elevation of the regions around the poles, whereby an ocean was thrown over the land, agreeably to the views of De la Beche, or by the elevation of different parts of the continents from the ocean, while the greater part of those continents was beneath the waters, according to Lyell and Murchison, I do not feel competent to decide. I rest at present in the position that ice and water were both concerned, and am in doubt whether geologists will ever be able to go much further and remain upon the *terra firma* of logical induction. But to have reached this principle, in which I fancy nearly all geologists now agree, seems to me an immense advance on this subject, and for this progress in my own mind I feel greatly indebted to Agassiz." In another sentence he adds: "It will be seen that my mind was entirely unsettled as to the origin of the ice and water which have pro-

duced the drift, and that I was quite as favorably inclined towards the peculiar views of Mr. Murchison as of any other geologist."

These views, if they can be called so, were repeated by Dr. Hitchcock at the Albany meeting, in 1843, during a lively discussion on the Drift which was introduced by Dr. C. T. Jackson, with these words: "Many eminent men incautiously embraced the new theory, which, within two or three years from its promulgation, has been found utterly inadequate, and is now abandoned by many of its former supporters"—a rash statement, as we all now see clearly enough. Dr. Hitchcock saw its rashness then.

At the Washington meeting in 1844 he read a paper on the Berkshire trains, discovered by Dr. Reid. All that he knew of the Drift he had published the year before in his annual State Geological Report. This was a special and remarkable case. It has never been elucidated. Dr. Hitchcock describes the phenomenon, but leaves it unexplained. His conclusions are all merely negative, and exhibit, in a striking manner, the cautiousness and fidelity of his scientific methods. 1st. The blocks of the trains must have been scattered during the latter part of the drift period, and by the drift agent, whatever that was. 2d. It is impossible to explain the case by any merely aqueous theory of drift. 3d. It is equally impossible to explain it by icebergs; or, 4th, by river pack ice; or, 5th, by the medial moraine of a glacier; or, 6th, by reference to the unexplained patches of angular fragments on the Falkland Islands, described by Darwin. "In short," he concludes, "I find so many difficulties on any supposition which I can make, that I prefer to leave the case unexplained until more analogous facts have been observed."

At the meeting of the British Association at Edinburgh, in 1850, he read a paper upon his favorite subject, the terraces of the drift period, after he had made a visit to Wales, where he at once recognized the marks of the former existence of glaciers up to a certain height, above which he recognized the marks of mere drift agency, and to Switzerland, where he confirmed his faith in the views which Agassiz had taught respecting the former extent of the grand glaciers of the Alps. But his Massachusetts experiences had so prepossessed him with notions of *modified drift*, that he thought he could see how the moraine matter of the plain of Switzerland had been subsequently thrown into terraces. He

was therefore prepared, on his return to England, to accept Ramsay's conjecture that there were two glacial epochs—one before, and the other after the drift.

The following year, 1851, he visited the White Mountains, and studied the effect of one of those tremendous stone-slides which have played so important a part in the reduction to its present level of the central *massiff* of New Hampshire, upon the face of the rock *in situ* over which it passed. Seeing no glacial markings whatever, he concluded that any aqueous theory of diluvial scratches must be insufficient. He had evidently come to feel the difference between the weight of a stone-slide, whether in or out of water, and the weight of a glacier or iceberg.

Finally, in 1857, appeared his contribution to the quarto publications of the Smithsonian Institution, called Illustrations of Surface Geology, in which he sums up his knowledge of the Drift. In the first part he compares the terraces of the Connecticut Valley with those of other regions. In the second part he discusses the modes and consequences of river erosion; and in the third part he gives the results of his previous five years' field work, devoted to the study of glacial striæ and moraines in the valleys of Massachusetts and Vermont. These moraines, he says, seem to him, like the Swiss moraines, to have been modified and obscured subsequent to their creation by another agency, which he does not distinctly call that of the Drift, but, as he expresses it, "by the long-continued presence and the action of water, as the surface emerged from the deep." Even at this late date, he had no distinct hypothesis to offer. He declared that he agreed more nearly with Mr. Redfield's views than any others. He thought "that the phenomena of boulders and drift should be attributed to mixed causes, and that the theories which refer these phenomena to the several agencies of glaciers, icebergs, and packed ice, are, in truth, more nearly coincident than is commonly imagined"! He found it (as Desor expressed it) "difficult to conceive how glaciers could exist and move in a wide and level country like the north part of the United States." And he winds up with these fine words, worthy of the man and of pure science, unsatisfactory enough to the theorist, but full of instruction for the neophyte: "I am aware that I am in conflict with the views of eminent geologists on several points; as I am, indeed, with my own opinions as held several years ago. And yet, for a long

time, I have stood chiefly aloof from the various hypotheses that have been broached respecting Surface Geology. But I could not refuse to follow where facts seemed to lead the way. It becomes me, however, to be very modest in urging my conclusions upon others. If they cannot adopt my explications, I hope they will, at least, find my facts to be of some little service in reaching better conclusions."

I must now say a few words about a third subject of investigation which may possibly in future time conduce more to his reputation as an original observer and bold thinker in geology than any other: I refer of course to his extraordinary statements respecting the distortion of quartz pebbles in conglomerate rocks. It is possible that I may be giving to the father credit for what is due to the son. But the two worthy geologists of Amherst represent to the world as yet but one Hitchcock, so amicably have they married their hammers and clinometers together.

It was at the last meeting held by the American Association for the Advancement of Science before the breaking out of the accursed rebellion in the States of this Union devoted to slavery—the meeting of the summer of 1860, at Newport—that a paper was read upon the conglomerate pebbles of the cliffs upon the southern shore of Rhode Island; attempting to show that they had been pressed out of their original globoid shape, flattened, elongated, curved into sickle-blades, and otherwise distorted, like fossil shells in semi-metamorphic rocks.

The opinion was expressed that this process might be found to have been carried on in all rocks, to an extent only limited by their degree of metamorphism. Of course the few geologists present at the meeting were not prepared to recognize the fact of such distortion in the evidently water-worn slaty pebbles laid before them as specimens. Nor will any geologist, I believe, who may have had a large experience solely among the conglomerate outcrops of No. IV., No. X., and No. XII. of the Palæozoic system, consent to this hypothesis of quartz distortion for an instant. I venture to assert that among millions of pebbles taken from the coal measure, or even from the middle silurian mountains, there cannot be discovered *one* bearing the marks of such distortion; although many of them offer plainly enough the evidences of wear and tear by fracture and the sliding of one stratum of the rock upon the other.

But if the geologist who has lived among unmetamorphosed conglomerates shall enlarge his experience by passing over into such a region as Vermont, where every magnesian rock has become either steatite, serpentine, talc-slate, or dolomite, where every argillaceous clay has been changed into pholarite, or roofing-slate, and every sandstone into quartzite, he may come to listen more patiently to Hitchcock's theorem—that gneiss is nothing more nor less than metamorphosed old conglomerates, wherein the pebbles have been pressed into laminæ composed of sections of the original matrix, themselves also pressed flat and thin. It is a bold assertion. It will demand abundant proof. The microscope will have something to say about it. Certainly it explains the folded veins of quartz in mica-slate, as no other hypothesis has done. It is consistent with the now accepted view of metamorphism by pressure, under the conditions of a moist, low heat. At all events, its ample discussion and copious illustration by Dr. Hitchcock and his son, in the pages of his report of the Geology of the State of Vermont, will remain a part of the classics of our science.

But the daring novelty of this excursion from the beaten track is heightened, when we see it as the short cut of an old man to regain the head of the procession. So far from leading him into isolation from his fellows, his path lay practically parallel with that of the best thinkers of the day. Most men of sixty-seven would tremble to adopt a new hypothesis. How few even at forty-five are able to be tolerant of newer principles! But Hitchcock could follow wherever Bischoff, Senarmont, Delesse, Daubrée, Sorby, and Sterry Hunt could climb. He could give up the igneous origin of granite, the extrusion of molten masses from a planetary nucleus of lava, the metamorphism of rocks by a high heat. He was no chamber geologist, and so kept his soul fresh in the open air that no new discovery could take him by surprise. "The opinion is now gaining ground," he writes, "that in many cases, perhaps in nearly all, they are merely stratified rocks, which by heat, or the joint action of heat and water, have lost their stratification and assumed new crystalline forms. They are, in fact, an extreme product of metamorphism." He no longer believed in those semi-theological central fires which no man has seen or can see; in those figments of the imagination, a thin floating pellicle or wrinkling epidermis to the earth; a uni-

versal granite floor, beneath the lowest sediments, azoic and aboriginal; a billowy deep of lava, generating earthquake cataclysms, and ejections of interminable branching dikes of trap and porphyry and syenite—which make the wall charts of Hall and D'Orbigny look now so old-fashioned, and which, in fact, the study of the Laurentian regions of the north, as well as the calculations of physicists, have proved to be mere myths and fables of an olden day. What is to replace them, we know not yet, nor how to do without them in our Structural Geology. The situation of the geological world, just now, is not unlike that of the theological, with its Schenkels and its Colensos, its Ecce Homos and its Leben Jesus. But this is certain—the empire of truth is of perpetual divine right, and cannot be shaken, its motto being, *fiat justitia, ruat cœlum*. What cannot be demonstrated, is fictitious; what has been disproved, is not useful. Better get our first conglomerates from aerolites which we can collect and exhibit in our cabinets than from an aboriginal granite floor which no eye has ever seen, no hammer struck, no foot-rule measured. Better redraw all the anticlinals and synclinals of our cross sections, than gabble about the plications of a crust which seems to be a demonstrated mathematical absurdity. But the fine life-history of him whose eulogy we read to-night tells us a better way. Facts take time. It is not hard for honest folks to wait. All harvests are not for this generation of sowers and reapers. It would be well for all of us, could our enthusiasm, like his, be tempered with conservatism, and our conservatism be fired by an equal expectation of better things to come.

Here, gentlemen of the Academy, I must most unwillingly stop. I cannot give you, as I should like to do, a description of the geological survey of Massachusetts which occupied Dr. Hitchcock from 1830, when he was appointed to it, to 1841, when he published his final report; and again from 1852 almost until his death; nor of the geological survey of Vermont, which he reorganized in 1856, and published in 1861. I cannot even tell you, in the few minutes that I feel are all I have to spare, how greatly we owe to his enlightened exertions that movement of the public mind which about forty years ago produced the early State surveys; nor how much to him should be ascribed the merit of originating, or rather pressing to concreteness, the abstract conception of the desirableness to science in America of

some closer personal association of its votaries. To him, more than perhaps to any other man, is due the title of founder of the association of American geologists and naturalists which afterwards assumed the name of the American Association for the Advancement of Science, which will hold its next meeting next week at Buffalo.

Neither can I describe Dr. Hitchcock as a teacher. His Elementary Geology, first published in 1840, reached its thirty-first edition in 1860, and was then rewritten to express the progress which the teacher himself had made. His Geology of the Globe was published in 1853.

Shall I allude to his scientific monuments at Amherst? I need only say to such of you as have not yet beheld them, Go and see what one man can accomplish! All honor to his fellow-workmen there! But what Amherst is, Hitchcock has made it—so says all the world, and what all the world says must be true. He was the master-mind at that centre. Let Amherst erect a statue to him in front of his Museum—a statue of pure, white Vermont marble, for he was an American Christian—a statue lifted high upon a cubical plinth of Quincy granite, for he was a simple-hearted son of Massachusetts—a statue facing Holyoke, for the oblique denudation of its summit, he discovered, and the marvellous beauties of its panorama were his heart's delight. America has reached the time when it needs the idolatry of hero-worship to counteract its excessive tendency to individualization, and its intolerant democracy. And this man is one of America's heroes.

He was, I have said, in some respects even in advance of his age. His theology was gentle, tolerant, and liberal. He was one of the first to recognize the claims to the honest attention of good physical observers which those strange and apparently abnormal physical phenomena make which went at first by the name of mesmerism, and which have been, since then, followed up and obscured by the fanatical and hurtful dishonesties and shameless and tasteless profanities of the modern round table. The evils attendant upon this strange psychological epidemic he was as quick to see as any man, and to recognize also its capacity for warping and marring the youthful science of this land; but no amount of materialistic denunciation from the side of specific science could scare this fearless investigator from confessing his faith in what of fact there was, so far as he could discover it, nor

from exercising the function of true science—to wash his facts from the filth in which they were rolled—to set them upon their appropriate shelves in the order of their worth.

He was by nature not a materialist and a scoffer, but a spiritualist and a believer. He believed in immediate creation by the fiat of God. He believed in the Hebrew poem of the creation as a substantial history. But even here he showed himself a man of genuine scientific spirit. He was obliged to interpret, and of course to criticize the Scriptures of his Church. But it is interesting to see how we always in this life return to our first loves. It was in his *later* years that he took up with zeal the defence of Genesis. He was forty-two and forty-four years old when he published, in 1835 and 1837, his pamphlet on the connection of Geology with Revelation, and his pamphlet on the historical and geological deluges. But it was not until 1851, when he was fifty-eight years old, that he gave to the world the first edition of his book, "Religion of Geology and its Connected Sciences," while his book of "Religious Truth Illustrated from Science" did not appear until six years later, when he was sixty-four years old. Of these and other works to effect an impossible harmonization of the developments of modern science with those of the ancient imagination others would speak to better purpose.

By his early personal devotion to field-work—by his long and successful college instruction of successive classes of young men—by the purity and simplicity of his personal nature, which roused no jealousy and excited no suspicion—by his cheerful, modest, but enthusiastic publication at all times of every new fact which he observed, and every new idea which facts observed gave birth to—and by his ready concurrence in every useful scientific enterprise, Edward Hitchcock shines a star of first magnitude in the heaven of American Science.

Do you expect me now to speak of his religion? I am not capable of the task. I hold it true that the Christian is a higher type of man than the Savant. His theology I reckon as of no account: it is his Christianity that crowns his brows with light, and arms his hands with power. He may be a Unitarian, as Edward Hitchcock was in early life, or he may return, as Edward Hitchcock did in after years, to the Orthodox notions of his fathers: it makes less difference than people judge of it. Science will settle all those discussions in good time. But no amount of

natural science will stand a man instead of faith in a higher law and an invisible world. No zeal for science will compensate for the lack of temperance, charity, and truth towards our brother man. It was the hold he had upon the Christian heaven that made this man, working among us like a brother, walk among us like a father, trusted and beloved by all. I do not believe in his theology: it savors too much of the central nucleus of fire; it makes our earth-crust too insecure; it is too full of old wives' fables. But we must all believe in his religion, and feel how grandly it ennobled his science, and glorifies his happy memory.