

A PLEA FOR SCIENCE:

AN ADDRESS

DELIVERED IN

MORRISON CHAPEL, KENTUCKY UNIVERSITY,

COMMENCEMENT DAY, JUNE 28, 1866.

BY

ALEXANDER WINCHELL, A. M.

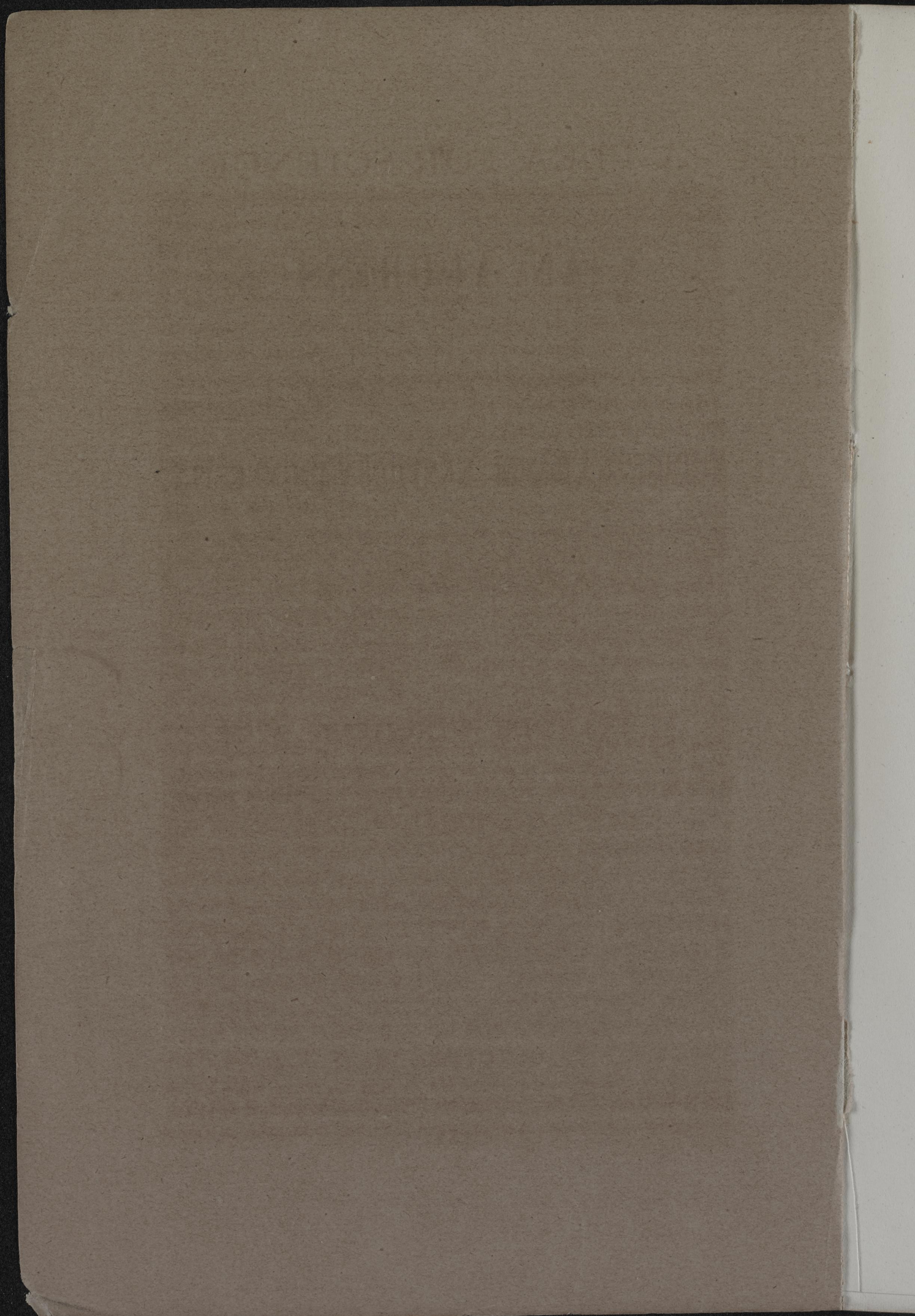
PROFESSOR OF GEOLOGY, ZOOLOGY AND BOTANY, IN THE UNIVERSITY OF MICHIGAN.

CINCINNATI:

GAZETTE STEAM PRINTING HOUSE, NORTHEAST CORNER FOURTH AND VINE STREETS.

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Edw D Graham



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CORRESPONDENCE.

LEXINGTON, June 28, 1866.

PROF. A. WINCHELL:

Dear Sir—The Executive Committee of Kentucky University, respectfully solicit, for publication, a copy of the very able and appropriate address, delivered by you this day in Morrison Chapel.

JOHN G. ALLEN, Sec'ry.

LEXINGTON, KY., June 29, 1866.

JOHN G. ALLEN, Esq., Sec. Ex. Com. Ky. Univ.:

Dear Sir—In compliance with your flattering request, received this date, I place at your disposal a copy of the address to which you refer, regretting only, that I had not the time to clothe in a more attractive and suitable style the thoughts which I have attempted to enforce.

Very respectfully,

A. WINCHELL.

A PLEA FOR SCIENCE.

LADIES AND GENTLEMEN :

Here in the midst of the classic associations, (I may add, the *venerable** associations,) of your chief University—gazing into a circle of faces which, though strange, seem to be responsive to the spirit of the occasion—with so many of the honored representatives of higher learning around me, and such an inspiring galaxy of well-intentioned eyes before me—I stand up to utter my *Plea for Science*.

Not that I propose to forget the demands of the occasion, by presenting you with an abstruse discussion. The *results* of science are all that the many demand; the difficult *processes* are for the initiated to thread. Nor do I speak of science shorn of her wings, and robbed of her soul—a plodding, calculating, earthly science, which never lifts her eye above the plane on which she stands, but works on from day to day, and from year to year, absorbed in the abstractions of her own thoughts. I speak of science with a soul fired with the enthusiasm of truth—science with an eye of light that glances from earth to heaven and from heaven to earth—science winged with the ardor of perpetual inspiration—that sends her glances down all the ranks of society, and seeks out opportunities for good—lays her hand upon the tide of nature and turns it into channels of usefulness—makes the laws of matter her servants—bids the lightning carry her messages—the wind to row her vessels—the steam to run on errands and perform

* The Transylvania University, which was recently merged into the Kentucky University, was founded in 1788, and was for years one of the first literary institutions of the country. Among its professors were such men as Rafinesque, Davis, Short, Yandell, Holley and Peter, whose names would adorn any University.

herculean labors. I speak of science which sends her vision along the trackway of light, and pursues the fugitive ray into the illimitable realms of space, waylays it, and extorts from it the history of six thousand years—science that can decipher the historic pages of the pre-Adamic earth, and, planting her foot upon an eminence of thought, can look up the channel of time to its very rise, and, turning, follow its winding course down through the ages yet to come. It is truth in all its relations, and adaptations and utilities—truth full-orbed, complete, swelling with exultation, bounding with emotion, of which I speak—divine science, such as thrills the souls of archangels, and admits us into communion with the thoughts of God. Blessed is he who can patiently travel the rugged road which leads to such ethereal visions and communings. Such science is worthy of our regard and culture. Such science is of heavenly birth, and lifts the soul of him who embraces it, to the atmosphere of its kindred heaven. If it is but groveling, earthly science of which you have learned, and of which you form your judgments, I beseech you make the early acquaintance of this daughter of heaven.

I said I had taken my stand to utter a plea for science. In what language shall I plead for science? How shall I most effectually commend her to your regards? I will show that she is your friend and benefactor—that she has created for you a thousand conveniences—that she has built up society—that she gives dignity to the body politic—that she has enriched your souls with thoughts of the invisible and the remote—that she has illuminated the dark chambers of the past, and reflects a light upon the future—that she interprets to man the thoughts of Deity, and opens perpetual communion with the world of superior spirits.

I. *Science in the Material World.*

If we take the lowest plane of relations between man and science for our first survey, where, in the *material world*, can we look and fail to witness the achievements of science? When we have enumerated all inventions—engines, machines, imple-

ments, tools and combinations of matter—all scientific explorations—as for undiscovered lands and seas, for coal, petroleum, artesian waters, the precious and useful metals—all devices for multiplying force, or velocity, or both together—all the contrivances for executing the most gigantic and the most minute manipulations—the manifold methods of increasing the convenience, health and physical comfort of individuals and communities in the forms and arrangements of dwellings, public houses, cars, carriages and other vehicles—the multiform varieties of flowers, fruits and ornamental shrubs and trees which have been created by culture and the science of hybridization—the subordination of the domestic animals—control of diseases, promotion of general health, and prolongation of average life—when, in a hasty survey, we take this first glance at the numberless cases in which science has adapted the laws of matter to the convenience and utilities of human life, who can fail to be impressed with the conviction that we owe much to science?

But we must distinguish, you say, between *practical* science and *theoretical* science—between book knowledge and experience. With all deference to prevalent opinions on the subject, I feel compelled to say that I am unable to make the distinction. I understand fully that by practical science you mean scientific principles that have received direct application to some economical purpose; and by theoretical science such principles as exist only in the abstract, not having as yet been actually utilized. Arithmetic you regard as practical, because it enables you to figure up profit and loss. Algebra and geometry you regard as theoretical, since you do not witness the application of these sciences in any of your occupations. Here is a man who has delved in a coal mine, and has actually witnessed the relative positions of coal and its associated rocks and minerals, and has learned the general topography of coal-producing regions. Such a man you style a “practical geologist,” and you will defer to his opinions. Here is another man who has studied the bonds of connexion between different coal regions, and has traced their connexion

with the general history of the world, so as to be able to draw from a single specimen the conclusion which the other man only doubtfully reached after laborious experiments. Such a man you style a theoretical geologist. Here is a man who learns by trial that his peaty lands produce feeble, yellowish corn; and, by trial, ascertains that the soil is improved by exposure to atmospheric agencies, and application of lime or ashes. Such a man you style a *practical farmer*. Here is another man who studies the record of this experience in a book, and learns that a peaty soil is damaged by the presence of vegetable acids which atmospheric air and alkaline preparations will either destroy or neutralize; this man you style a *book-farmer*; and "book-farming" is in bad repute.

Now it is quite obvious that some scientific principles lie remarkably near to their utilitarian applications, and that others are more or less removed; yea, in many cases, to the casual observer, are not seen to be related at all to any useful result. But more careful observation, and a deeper insight into the relations of nature suffices, often, even in such cases, to disclose a chain of relationship, binding the remote principle to present economy. What investigation more evidently fruitless of practical results than those of Oersted and Faraday, wasting days and nights in experiments to establish and elucidate the co-relationship of electricity and magnetism. Curious, it might have been said, but purely of a scientific and theoretical nature. And yet, but for the demonstration of this relationship, the electric telegraph and all the revolutions it has wrought would have been impossible. One man engages in the study of the physical properties of the various useful ores, and subsequently in traveling over an unexplored region, recognizes, as he thinks, the existence of valuable deposits of some metal. You at once perceive the utility of such studies, and encourage them. Another man occupies himself in the investigation of the organic remains of different geological epochs, and learns to decide the geological age of any formation, and its place in order of superposition, by an inspection of a few specimens of fossils. This, you think, the occupation

of the mere scientist—perhaps of the innocent but useless enthusiast. Presently, however, this useless enthusiast detects conclusive paleontological evidences that the formation in which the deposits of useful ore were supposed to be discovered, are quite too modern to justify the expectations raised. Indeed, the samples picked up are mere drifted fragments, imbedded in the other material of which the rock is composed. These are not imaginary cases. You have all heard of the gold brought up from some of the oil wells on Dunkard's Creek, in Pennsylvania. I have even seen reports of assays by eminent chemists, and one, at least, sustained by the signatures of the officers of the United States Mint at Philadelphia. Indeed, the visible evidences seem conclusive; and one sanguine company are engaged in sinking several thousand dollars in an exploratory shaft. More profound scientific attainments demonstrate the utter hopelessness of such an enterprise, and prove, by a logical inference, the forgeries that have been perpetrated upon credulous capitalists who are putting in the hole the only gold it will ever be found to contain.*

In the extreme Northern part of the lower peninsula of Michigan, are found numerous fragments of a black substance in every respect resembling coal. It is so pronounced by chemists and minerologists. Many hundred acres of land have been taken up in the belief that inexhaustible mines of coal were destined to be discovered. But alas! the man who studies the curious organic remains, found imbedded in the rocks of that region, declares that they belong to corals and shell-fish which lived and died many ages before any accumulations of coal took place upon the earth. The coal, however genuine, is only inspissated petroleum accumulated in the crevices of the limestone.†

I cannot discern that one portion of science is essentially more practical than another. That which seems to be most purely theoretical, may be on the eve of blossoming and bear-

* Compare J. P. Lesley: Proc. Amer. Phil. Soc. Apr., 1866.

† Winchell: Geolog. Rep. Mich. 1860; also, "The Grand Traverse Region."

ing fruit. This has happened in hundreds of cases. When we look at the matter abstractly, and inquire what is a useful invention or device, we are met by the response that it is simply the work of some one who has found out how to turn the laws of nature to useful account. Of course, the inventor must first have understood the laws of nature so converted. The laws themselves were of the same nature before as after conversion. A knowledge of them was just as essentially practical before the invention as after it. Chemists have long known how to operate on dolomite to extract from it magnesium; but this knowledge has been regarded as purely scientific, like the process for solidifying carbonic acid. Now, however, we find that the combustion of magnesium affords a most intense illumination, with an actinic or chemical force many times superior to sun-light of the same intensity; and magnesium is likely to come into great request for illuminating and photographic purposes. It has already been employed in taking photographs of the interior of the pyramids. A knowledge of the method of extracting it from dolomite has become eminently practical. Was it less so last year?

Indeed, the more we consider the matter, the more obvious it becomes that we are indebted to a knowledge of scientific principles for all of those inventions and devices which characterize our modern civilization; and the more obvious it likewise becomes, that there is no place to draw a line of demarcation between science which is to be valued for its practical relations, and science which ought to be regarded as purely theoretical. The only philosophical view is that which traces the capability of usefulness in all science; and discovers that while all inventions are but economical applications of the laws of nature, the probabilities of a discovery of such applications will increase as our knowledge of these laws becomes more profound. In this view, the most practical science is really that which is most profound.

Our apprehension of the utility of higher investigations is liable to be obscured by the fact that the man who investigates, and he who applies the principles are seldom united in

one person. An eminent scientist may invent nothing. An eminent inventor may be a novice in science. The history of the ideas, and the chain of connexion which binds the latest results to the earliest, know nothing of the two individualities; and, for our reasoning, they are essentially one.

I forbear to enter into details under this head. They would swell into immeasurable proportions. Witness at large, the transformations which science, and art enlightened by science, have wrought upon the face of the earth. One hundred years ago what scene extended itself across the valleys and plains of this beautiful State? The primeval forest held undisputed possession of the soil. Its ample branches afforded a secure retreat for the lurking panther and the wild-cat, while its grateful umbrage sheltered the prowling bear and the wolf. The timid fawn stole cautiously to the licks which its ancestors had frequented for unknown ages, while the untutored savage lay in wait with his nimble bow to secure the unsuspecting visitant for his meal. The rivers rolled as now, and the summer-cloud, in passing, shook from its misty folds the invigorating drops in the smiling faces of the forest leaves. The mountains anon reverberated with the voice of thunders, and the electric bolt rent many a sturdy tree. When the storm retreated, the seven-hued bow smiled its promises to wild woods which responded only with the voices of myriad birds. Civilized man there was none. Mountain crag, and smiling valley, and fertile plain, and shady gorge, and deep and awful cavern spoke equally of the solitude of the unbroken wilderness. No sound of human industry rose through all the goodly land.

Turn now to the scene which presents itself to-day. Did magic ever work more wonderfully? The primitive forest has vanished like a morning fog. The panther and the wolf have retreated like the savage from the presence of educated man. The palatial steamboat has supplanted the rude canoe in the navigable streams. The finished turnpike takes the place of the Indian trail; and the wigwam has yielded to a hundred thousand mansions, wrought, either from the century old oak,

or the clay or stone which, since before the creation of Adam, had been waiting for this age. The fruitful soil is teeming with its abundant crops. The wild haw has given place to the purple damson—the austere persimmon to the melting peach, and the bitter crab to the luscious and juicy greening. The landscape spreads out like a vast plaid, checkered with alternating fields of corn and grass, and embroidered with innumerable gardens. Passing the northern confines of the State, the locomotive with its fearful energy and power threads its iron way through valley and hill, and across the wide extended plains to its exit over the southern boundary. Everywhere is the hum of industry—the trace of enterprise—the footprint of civilization—the metamorphosis wrought by science.

Science, presiding in the workshop and in the field has transformed the face of nature—has changed the river's bed, and created rivers where none existed before—has hung suspension bridges over gorges hundreds of feet deep and a fifth of a mile broad—has reared castles and cathedrals which defy the wasting energies of time as if they were the very mountain cliffs—has walled cities and even empires—called into existence pyramids which vie with the Alps in solidity and durability—harnessed the winds and the very lightnings—chained the sea—subdued encroaching sands—tunneled the mountains—plunged into the rocky recesses of the earth and stolen its iron and lead and coal and precious metals—swept whole faunas and floras from existence—erased forests—dried up rivers—parched the soil, and changed the climate of whole countries. All this man has done—not savage, uneducated man—but man enlightened by science. All honor, all praise, all blessing to science that so magically changes the wilderness to the home of civilized industry and happiness.

II. *Science in the Intellectual World.*

Such are the works of science in the material world. What must they be in the world of mind—the domain in which her supremacy is conceded? The realm of science is the home of thought. The truths of science are the nourishment of the

soul. Shut out from communion with the ideas that float in the atmosphere of thought, the mind dwarfs—its perceptions become dull—its actions cold—it ceases to soar—it grovels awhile then plunges into the abyss of bestiality and savageism. When science ceases to present her truths, the mind ceases to think—then loses its inclination to think—then its ability to think. When man ceases to think he becomes a savage. When science holds up her truths for the soul's contemplation, they inspire the soul—they enlarge and ennoble the soul—they turn its attention from the *forms* of material things to the thoughts which they clothe. To the instructed soul all nature is vocal with suggestions—every phase of nature becomes a book, all luminous with teachings. If the mind of man is, next to his moral nature, the endowment which distinguishes him from the brute, and makes him a higher, more susceptible and happier being, then how desirable that this part of his nature receive the utmost possible development, that he may become as exalted and as noble and God-like as his Creator has fitted him to be.

Is there a person within the sound of my voice that can fail to appreciate the dignity which knowledge confers upon the soul? How exalted, and free, and intelligent the outlook of our own minds upon the universe, when contrasted with the ancient idea that the world was a vast plain, and that the sun, and moon and stars made daily journeys over it! Now, how vast the scope which science has given to the imagination! Our world a globe of land and water hanging suspended in the balance of two forces—revolving, with the other planets, in a mighty circuit about the sun; our sun itself a star—one only of the brotherhood of suns which shine in the vault of heaven and constitute our firmament—revolving all in unison about a common center of gravity; our firmament itself but one of the many which hang in infinite space—each cloud-like nebula which the telescope reveals when we look out through the loopholes of our firmament into the dark and vacant space beyond, being another firmament like our own—each with its thousands of burning suns, and each sun with its attendant primaries and

secondaries—each of this immensity of firmaments revolving on its own axis, and the whole family, undoubtedly, revolving in an inconceivably majestic sweep about some general center. And who shall say there exists no other center about which sweeps an equal retinue of firmaments, and systems, and primary and secondary planets? And whose thought can climb high enough—whose imagination stretch far enough to reach that final center of the material universe around which all created things are moving, and on which fancy would fain erect the luminous throne of Omnipotence? Science, it is true, is scarcely able to lead us so far; but she points out the way, and the soul delights to stretch her wings in a flight so vast.*

Who would exchange such sublime conceptions of the structure of the universe for the insufficient and puerile imaginings of the Chaldeans, Egyptians, Indians and Chinese?

Behold another striking development of science. Observations made with an accuracy, which is itself almost a miracle, have furnished the data for computations correspondingly vast and wonderful, demonstrating that a ray of light travels through space at the rate of 192,000 miles in a second. And yet the nearest fixed stars of our firmament—"the next door neighbors" to our own sun—are so remote, that three years are occupied in the passage of light from them to us; and if one of them were annihilated to-day, it would continue to shine in its place till the year 1869. Other stars, situated in the remoter regions of our firmament—always remembering that a vast void intervenes between the exterior limits of our firmament and the nearest nebula—are removed to such an inconceivable distance, that from ten to three hundred years are required for their light to reach us. We have recently witnessed in the constellation of *corona borealis* the conflagration of one of these suns. A star which, from time immemorial, had been invisible to the naked eye, began to blaze with

* Compare Nichol on "The Architecture of the Heavens;" Alexander "On the Vastness of the Visible Creation," Smithsonian Report, 1857, p. 169; Madler "On the General Movement of the Stars around a Central Point," in *Bibliothèque Universelle de Geneve*, 1859.

unwonted splendor ; increased in brilliancy till it became distinctly visible to the unassisted eye, and then, like the star which burned to cinders before the eyes of Tycho, it gradually faded, and is apparently destined to disappear from the map of the heavens. We look upon the marvel and think we are witnessing a conflagration in the moment of its occurrence. How amazing the thought that these events occurred more than fifty years ago—perhaps even before the American Revolution—and the announcement of them has been on the wing through mid-space for half a century before it reaches us !

What shall we say further ? Some of the *nebulæ* are believed to be so amazingly remote, that their light could not have reached us since the creation of man—proving, it may be remarked, that they have been in existence more than six thousand years.

Whither has fled the light which emanated from our planet in the morning when it was finished, and our first parents were placed in possession of it ? Some of the rays met the vision of intelligences living upon other planets. Some traveled on and carried the announcement of the world's completion to the dwellers upon the stars. Others have passed on through the immeasurable intervals, unintercepted by any astronomical body, and are still shooting onward, proclaiming to-day, in some remote province of the universe, the intelligence of a world's first creation. In like manner, the tidings of the second day's history of our earth are borne on the wings of light just one day's travel behind the first. And if we could travel all that shining path along which the luminous beam is making its flight, we should detect the image of each day's history in the whole life of our planet—a gallery of photographs hung upon the ceilings of immensity, preserving, perpetuating, forever reproducing the successive events along the whole cycle of human existence. The picture of Cain in the act of murdering his brother, is still in existence, and disembodied spirits may visit the apartment in which the picture hangs side by side with photographs of the other events of that day. Every secret act which the light of day has shone upon, has been

commemorated in the galleries of heaven. If you have perpetrated an act of shame, your conscious spirit will one day stand face to face with the full and public delineation of it upon the imperishable canvas of the universe.*

Science reveals to us an immensity of time-worlds, as well as of space-worlds. There are wonders in the phenomena of duration, no less than in those of extension.

In 1842, a careful trigonometrical survey was executed of the shore-lines and land-marks of Niagara Falls.† In 1855, twenty-three years later, M. Marcou made careful re-examinations, which he has reported to the Geological Society of France.‡ From these data it appears that the Canadian Fall, over which the largest body of water is discharged, has receded, by the wearing of the rocks, to the extent of twelve feet, or a little more than six inches a year. This observation furnishes us with a clew to the determination of the whole time required by the river to excavate the whole length of this stupendous gorge, from Lewiston to its present position, a distance of seven miles. The result is over 70,000 years. If we make every possible allowance for difference in the rate of retrocession at some former period, it is obvious this enormous piece of engineering has consumed not less than 500 centuries. The breadth of this gorge does not average 1,000 feet, and its depth does not exceed 250 feet.

If we turn now to similar work which has been carried on along the rivers of the western part of the continent, we witness results still more amazing. The Rio Colorado, for two or three hundred miles of the upper portion of its course, flows over a vast sterile plain, composed of horizontal beds of rocks. Through these the river, in the course of ages, has dug a channel with nearly perpendicular walls, in some places of more than a mile in depth!§ The traveler across the plain finds him-

* Compare an anonymous little work entitled "The Stars and the Earth."

† Hall: Geological Report, 4th Dist., New York.

‡ Bulletin de la Societe Geologique de France. 2d Series, t. xxii, p. 190.

§ Newberry: Colorado Exploring Expedition, Part III., p. 42, et. seq.

self suddenly standing upon the brink of a fearful chasm six thousand feet deep, at the bottom of which a silvery stream winds its quiet way—the gentle but patient laborer that has scooped out a gorge of such dark and fearful dimensions. If Niagara, with his ocean tide of waters, has consumed 50,000 years in wearing a gorge but 250 feet deep, what ages have passed away while the Colorado has been at work upon a gorge 300 miles long and from 3,000 to 6,000 feet deep? And yet when we have computed the myriad ages which have elapsed while these changes have been in progress, we must remember that these are only some events which have transpired subsequently to the last of the great revolutions of the earth. Before the work was begun upon the grand gorge of the Niagara, and, perhaps, even of the Colorado, the earth was witness to a reign of ice, when, as we have reason to believe, enormous glaciers, thousands of feet in thickness, rested over the land.* These, by their annual expansions, moved forward, mowing down the forests, planing off the mountain crags, plowing up the underlying rocks, and grinding them to a powder, from which our soils have been formed. How many ages were occupied in the growth, the labors, and the dissolution of these continental glaciers, science can only conjecture.

But even previous to the reign of ice, the earth, in the progress of its preparation, had reached comparatively so near completion, that the vegetation and most of the animals in existence belonged to the same species as now occupy the earth. The very concluding passages of the world's history contain revelations of a lapse of time which staggers our imaginations. What can we say, then, of the body of that history, recorded upon a thousand strata, piled fifteen miles in height, and formed of sediments which slowly accumulated along sea-shores, or in the clear and quiet depths of the ocean? What shall we say of the incalculable interval of time

* Agassiz: "Geological Sketches," and elsewhere; Winchell: "Voices from Nature," 1864.

preceding the commencement of the accumulation of sediments, while the earth was cooling from a molten condition—aye, from the condition of an igneous vapor, spreading itself out to a diameter of millions of miles? To such conceptions does the study of a pebble elevate the mind.

I must forbear to cite further illustrations. It would be delightful to review the past history of our world—to find it mingled, at first, with the common mass of igneous vapor—to note how the mass cooled, and shrank, and began a rotation*—to mark how planet after planet leaped out from the fiery abyss—how our mother earth endured the early ordeal of fire—how, in the progress of cooling, a crust formed over the surface of the molten globe—how, at a later period, the vapors gathered in the murky and poisonous air, shutting out the light of the sun, and moon and stars—how the rains descended and the thunders raged during a geological æon†—how the crust was a hundred times erupted—how the continents were born—how the domain of the sea was wrested from his grasp—how every element and every place found, at all times, its fitting inhabitants—how the evidences of a single plan run through the entire history of this creation—how man comes on the earth, and finds himself one of the actors in a vast drama which is still in progress. These are wonderful topics, and fill our souls with inspiration, and make us live above the visible and the present, and become spiritual dwellers in eternity.

One thought, despite my resolution, I venture to present. We have evidences in the records of science, that the machinery of the universe is running down. This intimation comes to us from different directions.

I have just alluded to the fact that we come upon the earth in the midst of a drama. We witness a work in progress. We note the amount which has been accomplished, and estimate

*La Place and Herschel; also "Vestiges of Creation."

†Winchell: "Voices from Nature," where this early history is traced more in detail.

the time that has been occupied. We observe the tendency of events, and calculate what further can be effected by the continued operation of the same causes. Thus, we have measured the work at the gorge of Niagara, and ascertained that, though vast, it had a beginning. With equal ease we compute the consequences of a continuation of the same action in the distant future. We conclude that the Falls will disappear—Lake Erie will be drained, and, perhaps, Lake Huron and the whole chain of lakes. We turn our eyes to another set of operations. The Mississippi is bearing a perpetual burden of sediments to the gulf. These sediments are the wear of the continent. The Missouri brings them down from the distant slopes of the Rocky Mountains—the Illinois contributes its quota from the solid land of the Prairie State—the Ohio brings down the pulverized rocks of New York, and Pennsylvania and Kentucky—the Tennessee bears forward the contributions of the tablelands of the Cumberland range. And so from east to west the solid substance of the continent is wearing away and traveling toward the sea. On all sides of the world, the storms of heaven are in league with the rivers to level the mountains, and bury their remains in the ocean. If this operation continues, the mountains will disappear, the continents will subside, the ocean will be filled, and his waters will again, as in the beginning, hold undisputed possession of the globe. Do you say that volcanic agencies are at work rebuilding the continents? I reply that volcanic agencies are wearing out. Their phenomena belong to the earlier history of our planet. The doom of our continents is perfectly legible. The duration of our race is fixed by a mandate of nature. The human race, like that of trilobites and crinoids, is destined, in some distant age, to be known by its fossil remains.

But even admitting that volcanic forces could continue for ages yet to counteract the leveling forces of nature, how long before this reservoir of force will have become expended? We believe that the earth has cooled from a state of fluidity—we have proof that it is still in process of cooling. However slow and imperceptible the process, eternity affords ample time for

its completion. This, like the leveling of the continents, is only a finite work. The great globe itself is destined to feel the rigors of relentless and universal winter. Even now the chill of death creeps through its members, and we detect the sluggishness of approaching dissolution. Insufferable and relentless frost will therefore terminate human existence if the sea does not sooner swallow up man's terrestrial habitation.

One refuge presents itself, perhaps you say, from a fate so rigorous. The genial sun will never suffer this earth to become a frigid mass. What is the sun himself on which you rely for an exhaustless store of light and heat? The residuum of that igneous mass from whose bosom the planets in succession have leaped forth. What shall prevent this residual mass from yielding to the same law of refrigeration which is chilling the planets that were once as incandescent as the sun? What exempts so grand a combustion from the fate which follows a lesser conflagration? Whence the fuel to sustain so mighty a fire without the danger of exhaustion? I venture to assert that no replenishment of the solar fires has been provided. The great sun himself is burning up. Year by year his force is becoming less. We may not, in our ephemeral lifetime, be able to detect its diminution. A holiday bonfire outlasts the life of an ephemeron. A molten lava stream consumes a century in cooling. A mass so stupendous as the sun, will continue to shine while a thousand generations are passing; and yet, obedient to the universal law, it is destined to become but ashes and cinders. The chill of death shall creep through the body of the great orb, and through all the planets that have been warmed by his smile. The evening twilight of creation approaches. The shades will darken, till, like a cold funeral pall, they shroud in silence and midnight every corner of the solar system.* Where, then, shall man be found, and in what sphere shall his divine activities be resumed?

* On a final catastrophe in nature, see Winchell: "Cycles of Matter," 1860;" "Voices from Nature," 1864. On the exhaustion of the sun, see Meyer: "Celestial Dynamics;" Hinrichs: "Planetology."

But the tidings of dissolution come to us from another quarter of the universe. Far away, in the machinery of the heavens, the sounds of friction are heard. The filmy comet is seen to plow its way with more or less of difficulty through a resisting medium. Its centrifugal force meets opposition, and the balance between centrifugal and centripetal forces is disturbed. The centripetal force, or solar attraction, slowly secures the mastery, and the comet, on each return, finds itself somewhat nearer the sun. The end of this progress must be final precipitation upon the body of the sun. That resisting medium, which can visibly disturb the movements of the filmy comet, must have a similar though less sensible effect upon the solid planet. Every member of the solar system is, therefore, in its successive revolutions, approaching nearer and nearer the sun; and when they shall successively have run their career, they will plunge, by turns, into the bosom of the luminary from which they sprang forth. In the far distant ages, therefore, the entire material of the solar system will be aggregated at the center of gravity—a lifeless mass—a dark and frigid mass—no more radiation of light or heat; these agents will have been uniformly distributed through space.

The fate which hangs over our own sun awaits alike every sun and every system of our firmament. And is it too much to assert that the matter of the firmament will be gathered together in obedience to the same mandate to which the planets must yield compliance? And where shall the operation of these laws be arrested till all the matter of the universe is gathered into a general mass? A mass in which the elements will be no longer struggling for their equilibria. All substances will have found their affinities. Heat and cold will have been equalized. The two electricities will be firmly locked in a death-like embrace. Stagnation will reign supreme. The motions generated by the struggle of matter to obey the law of gravity, will all have been executed. No more matter will exist in the universe to descend toward a center of gravity. The movements generated by the struggle of the electricities to unite will all have ceased. The radiation of caloric, and the

movements produced by changes in its distribution, will all have ceased. All material forces will have reached their equilibrium. This will be the death of matter.

What, then, are all the phenomena of this moving, bustling scene which we witness during our brief lifetime? What is all this heaving of the mountains, in a former age, from the depths of the sea—this scooping out of the beds of oceans and lakes—this piling up of sediments—this burial of cubic miles of the relics of successive races of animals—this flow of rivers—this beating of torrents—this voice of thunders—this solar heat—this race of the planets about the sun—this winding up of the career of comets—these plaintive prophecies of a final catastrophe to our earth—what are all these but the incidents attending the struggle of the forces of matter to attain their equilibria? The struggle to us seems long. The strife may appear the normal and permanent condition of things; but, if we reason aright, it is all but a passing phase. The magnitude of the movements bewilders the mind; but the careful observer notes the direction in which the forces are tending. The arrow is shot forth, and is winging its way along the path prescribed to a projectile. It is still in mid-air, but we know whither the laws of its motion will carry it, and confidently assert that it will come to rest. So of the great universe.

Will this be the end of the history of matter? These results will have been reached while yet eternity is in the future. But the forces of matter can go no further. Omnipotence alone can resurrect the universe. When He speaks, the imponderable agents will rush from their tomb, and introduce a new commotion in universal matter. Chemical unions will be sundered. Heat, light and electricity will be again aroused to action. All the caloric of the universe will be gathered together, and the blackened mass of matter will dissolve, and glow, and leap into vapor. Then will begin again the old struggle of the forces of matter to gain their equilibria. Then system on system will be evolved in due succession, and all the history of a forming world will be again enacted. Other worlds will again sustain their populations of intelligent and

unintelligent beings; and by degrees old age and decay will come along, and at length universal matter will rest again in its ancient tomb—again to be aroused to life at the sound of the omnific mandate.

Such are some of the views which science unfolds to the mind. The haste with which I have been compelled to sketch movements which involve at once all space, all time and all matter, prevents me from elucidating and enforcing the positions taken. But what has been said may open the way to some grand conceptions, and plant the germs of future reflection. My only object in citing these passages from the testimony of science has been to illustrate the expansive and ennobling influence of scientific truth upon the mind.

I ought here, in further illustration of the value of science in the intellectual world, to set forth its relations to education—especially to popular education in the promotion of which society is profoundly interested. It would be profitable to inquire what education really is, and to show how the results of higher scientific investigations gradually distill into the formulas of the school-room. It would be a pleasing and appropriate opportunity to portray the influence of higher seminaries for education. I am compelled to proceed, however, to another branch of my subject.

III. *Science in the Moral World.*

Facts and views which are capable of producing an impression so profound upon the intellect and imagination, must necessarily exert a powerful influence upon the moral nature. That this influence can be anything but salutary, I believe no one will pretend. The very communion with such thoughts must exalt and purify the soul. The mind gains access to some truer and more adequate conceptions of material things in their tremendous scope, and learns something of the true relations of the parts; and how insignificant a creature man is in the universe. We cease to attribute great dimensions to the earth, and look upon a century—nay, the life time of our race—as no more than a moment of duration. One of those

vast cycles of matter is but a single beat in the pendulum of of eternity. What humility such conceptions must teach! What a spirit of reverence must be cultivated in the presence of thoughts so vast—in the presence of plans so all-embracing and so all-enduring! And then, if the magnitude of that which we can understand must teach humility and reverence, how much more those great movements and forces and phenomena whose explanations baffle our highest powers! Whence comes the matter of the universe? Whence sprang those forces that impel it through a myriad evolutions, lasting through a myriad ages? Whence emanated that life which has teemed upon the globe through all the periods of geological history? Whence came we, and whither are we tending? How vast is space; and if infinite, is it filled with material works? Had material existence any assignable beginning, and will it have an end? What is the nature of electricity—of gravity—of chemical affinity—of light and heat, and how are these agents convertible? What is the vital force, and what is death of the plant and animal? Is matter composed of finite atoms, or is it only a phenomenon of force? In the presence of such mysteries, quietly withstanding all our feeble attempts to resolve them, what soul does not confess its weakness, and ignorance and insignificance?

If the framework of the universe is so vast—if through ages inconceivable it has gone through evolution after evolution—if, after all our searching there are still so many stupendous truths that tower above our comprehension, how utterly insignificant and contemptible become our little differences of opinions, or tastes or interests. How supremely absurd—in the presence of the catholic and sacred spirit of truth by which we are surrounded, how profane and wicked the wrangling over a dogma—the bitterness of spirit toward a fellow-mortal, even if an enemy—the hoarding up of an injury—the ceaseless, unreflecting scramble for riches—the senseless ostentation of extravagance in expenditure—the beastly indulgence of the passions—the slothful waste of time, and physical and mental energies. If noble science does not cultivate in the soul the

virtues of forgiveness, and generosity, and temperance, and industry, and economy, I certainly have taken a very erroneous view of the influence which she exerts.

Science develops the *religious* nature. In the presence of works more intricate than human ingenuity has ever devised, who can fail to recognize the evidences of a Designer? Placed in view of operations in the material world whose magnitude transcends the capacity of our arithmetic to express, who can fail to recognize the hand of Omnipotence? Amazed at the wisdom of the adaptations, and the incomprehensible breadth of the plans of creation, who can fail to recognize the guidance of Omnipotence? The finger of God is everywhere. The breath of God is in the breeze. The glory of God is in the firmament—in the rainbow—in the human face divine—in the petals of the violet and the rose. The thoughts of God are written upon every work—in the tiny vessels which convey the sap from the root to the leaf—in the co-adaptations of the vegetable and animal worlds—in the modifications of the limbs of animals to adapt them for air or earth or water—to enable them to walk, to fly, to swim, to dig, to climb, to manipulate—in the correspondence between the teeth and the digestive systems of animals, and between these and the localities in which they are found, and the resources by which they are surrounded—in the correspondence between a beautiful world and the sense of the beautiful in man—in the plans of animal structure, and the fidelity to four fundamental types in all the varied forms of creation—in the method of the development of continents and mountains, and ocean depths. Whither can we turn and escape the testimony of the intelligence and presence of Deity?

The *benevolence* of God is one of the most emphatic enunciations of nature. The nature of every being finds that for which it longs. Every faculty of the human soul finds an object provided for its exercise. And then in the arrangement of the material world, how obvious the provisions for the necessities of man and the lower animals. Myriads of ages before the advent of our race, the most magnificent and persist

ent movements were in progress, which could have no meaning if they were not intended for the uses of the coming man.

Science, moreover, teaches the doctrine of *one God*. We find nowhere any clashing of purposes. All is harmony and co-operation, and coadaptation. This unity of plan is historical as well as universal. The methods of progress in nature have been the same from the earliest ages of material history. The outlines of the American continent were marked out while yet no land existed except a V-shaped belt in the region north of the great lakes. The fundamental plans of animal structure were announced in the faunas which populated the seas in the earliest age of organic life; and they have been perpetuated to the present day.

Science furnishes us with intimations of *immortality*, and a life beyond the present. For what are all these vast evolutions of material things? Not for the brief possession and enjoyment of mortal man. The preparation bears no reasonable ratio to the consummation. This work is destined to be the study and enjoyment of the human mind through coming ages. Why all this lavish expenditure of wisdom and providence, unless, with a clearer vision, human intelligence is to be permitted to penetrate and understand it? Why all the longings of our natures, and of animal natures answered by the creation of appropriate objects, unless the highest longing of our nature—man's desire for immortality—is to be in like manner answered by the reality? Why this universal conviction of a hereafter, which we find implanted in the human soul, if it has not been inspired by the same God who has given utterance to so many other great truths in the universal instincts of man? Science assuredly cultivates in the human soul the faith in a hereafter.

In all these intimations the inculcations of scientific truth are in perfect accord with the doctrines of *revealed truth*. The occasion does not permit to particularize additional agreements. It is capable of proof scientifically that the eastern continent was destined to be the birth-place of our race, as the Bible teaches. It is capable of proof that man is to constitute

the final culmination of the series of animal existences upon the earth, as the Bible teaches. It is capable of proof that the progress of the world's preparation was marked off by stages which correspond with the six days of the creative week according to Moses—there being first the igneous period, in which *light* formed the dominant characteristic of the *first day*—a period of condensation of vapors, descent of rains, and separation of oceanic from atmospheric waters, constituting the characteristic events of the *second day*—a period of primitive marine vegetation, forming the dominant feature of the *third day*—a period during which the clouds dispersed, through the descent of copious rains, and the sun, moon and stars, by becoming visible were constituted to mark the periods of day and night; and these events characterized the *fourth* Mosaic day—a period when the preparation of the earth had advanced so far that marine animals, and after them, birds, were brought into existence and constituted the dominant features of the Paleozoic and Mesozoic ages, or *fifth day*—a period when terrestrial animals, and lastly man, were introduced, marking the Cenozoic and Human ages, or the *sixth day* of creation—the present era being God's day of rest, or the *seventh* Mosaic* day.

These correspondences a sound philosophy should anticipate. Science and the Bible being both equally the manifestation of Deity, it is absurd to anticipate or fear a clashing. The most extraordinary, or so-called heterodoxical revelations of science are to be received with the same composure as the exegesis of a passage of Holy Writ. When correctly understood, the two, instead of conflicting, will always be found to strengthen and defend each other. And so we may hail true science, not only as the inspirer of *religious sentiments*, but the bulwark of our common *Christian Faith*.

IV. *Science the Patron of Civilization.*

Let us now consider the influence of science in a more general scope. The boast of the nineteenth century is its civili-

* See Appendix.

zation. We speak with pride of the civilization which has been reared in America. The Englishman, the Frenchman and the German feel a kindred pride in the civilization of their respective fatherlands. A high degree of civilization we regard as an ornament and honor to any nation. It is something to be coveted and cultivated. It gives a nation the elements of perpetuity, at least in its fame. The great nations of antiquity are famous only in the ratio of their civilization. Their existence and career have been useful to the world only in the ratio of their civilization. A sound civilization is something to which all governments aspire, and which all good citizens study to promote, both for their own and their country's sake.

But what, let me next inquire, constitutes a high civilization? *It is merely an advanced state of MATERIAL, INTELLECTUAL and MORAL culture.* I will not omit one of these elements of a high civilization. I cannot agree that a high civilization embraces any features that may not be ranged in one of the three categories of material, intellectual und moral. But let it be understood that I regard Christianity—the patron of science—as a great moral force, perfecting, hallowing, utilizing the highest civilization of which the race is otherwise capable.

Now, we have discussed the part which science contributes to the material prosperity and the intellectual and moral character of a people. Next to the idiosyncrasies of the race of which a nation is composed, I believe no power is so efficient in the development of industrial resources, in enlarging and liberalizing the general mind, and infusing moral stamina into the general character, as enlarged views of the scientific relations of material things, generally diffused amongst the people.

This diffusion of scientific ideas is the work of education. There must be schools in which the work of popular education is prosecuted. These schools must be provided with the most competent teachers possible. These teachers should be full of the subjects they undertake to teach. They must, therefore, be themselves schooled in a higher school. And these ideas

which it is the work of the teacher to disseminate, must first be developed, and brought out to the view of the world. Here is the work of the higher seminary of learning, and of those who may labor within its precincts. Popular education is good—is indispensable to that general information which blossoms in the highest civilization. But since teachers must be prepared before they can teach; and since ideas must be originated before they can be disseminated, it would seem that the university is quite as essential as the common school. *The University is the germinal point of popular education. The University is the great engine of higher civilization.* This truth has been attained by all the civilized nations of the earth. The Universities of the Old World are not only the pride and boast of its citizens, but they are the perennial fountains of its civilization—the bulwarks of national perpetuity. In the Universities of Europe were trained the minds which have wielded the moulding power of modern institutions and ideas. Of these, many illustrious names belong to woman. In the Universities of Europe, and in her learned Academies and Societies—which are Universities developed only in special departments—were originated the principles which have entered into the construction of steamboats, bridges, locomotives, telegraphs and the thousand other inventions which have revolutionized society, and set the world forward in a progress tenfold increased. In the Universities of Europe and America were evolved those comprehensive and profound views of nature which mark the scholarship of the present age, and constitute a prominent feature of our modern civilization. In the Universities of Europe and America were brought to light those instructive moral lessons which have so appealed to the consciences of thoughtful persons, that it may in truth be said there is not an eminent scientific man in our country who is not a devout man. Civilization without institutions of higher learning for both sexes, is an impossibility which has never been witnessed and never can be. These utterances may seem extravagant to some, but I conjure you ponder well what has been said.

V. *Science the best Friend of Kentucky.*

It only remains to make an application of the principles which have been enunciated. The people of Kentucky, I have no doubt, are earnestly desirous of prosperity, renown and happiness. The way is open; let them enter it. I believe the best judgment of mankind will sustain the assertion that the highest prosperity, the noblest renown, and the most exalted happiness have existed, in all the history of the world, in connexion with the highest civilization. If Kentucky would become pre-eminent among the States, let her not rely upon her central position—nor her geographical extension—nor her well attempered climate—nor her prolific soil—nor her mineral resources, to elevate her to the status she covets. All these resources of prosperity, renown and happiness were here while the red-skinned savage wasted his life in ignominy, obscurity and misery. These are not the *forces* of civilization. They are the *materials* of civilization; and happy is that people that knows how to use them. High intellectual culture fostered by the authority of the State—highly qualified teachers disseminating the seeds of truth throughout the population—general information with its liberalizing, purifying and health-producing energies—these are the forces of civilization. These lay hold of the materials at command, and convert them to prosperity, renown and happiness.

An opportunity, in some respects unequaled in the history of the States, presents itself to the people of Kentucky. In the first place, her position is central, like that of the heart in the body. Characterized by no extreme of climate or opinions, she sympathizes enough with all to place them under contribution to her wants. A great State, lying with her feet bathed in the waters of the Mississippi, and her head pillowed upon the ridges of the Appalachians—with one hand resting upon the States whose marts are on the great lakes, and the other holding converse with those whose metropolis is on the seaboard or gulf—a State blessed with marvelous richness of mineral and agricultural resources, and a climate to which the citizen of the lake region takes refuge against the inclemency

of winter, and the citizen of the gulf region against the severity of summer—with lands already improved—with wealth already accumulated—with a fame and prestige equal to any—it seems as if Providence had purposely selected Kentucky, and purposely prepared Kentucky to become the seat of a great University, which should be the agent and engine in the creation of a higher and truer civilization than has yet been realized in America. How such incentives should inspire the heart of every Kentuckian, and of every lover of science, of civilization, and of his country!

And here is that University, planted in your midst. A noble germ; may it be nourished into a noble and vigorous life!

Men of Kentucky! Women of Kentucky! How magnificent an opening is before you! Let the eyes of the whole people be turned toward it. Let the people be united in heart and action. Let them speak through their legislature. Let them command the public treasury to be opened. Let them make here an investment for science—for literature—for art—for civilization—for religion—for the fame of Kentucky. Erect here a University worthy of the name—a great, and consequently an efficient, a beneficent University—one that we shall not blush to name by the side of the venerable Universities of the Old World—a fountain of learning, pure and undefiled—a seminary for the sons of agriculture throughout the wide bounds of the State—a nursery of noble teachers fitted to induct the mind of childhood to the threshold of the temple of science—a school of religion where all may receive an insight into the plans of Deity, and fit themselves to instruct in sacred truths—the guardian and promoter of civilization—the beacon-light of Kentucky, which the nations shall behold from afar—a monument of greatness, which shall make the fair fame of your State more enduring than the pyramids.

APPENDIX.

GENESIS AND GEOLOGY.

The following Scheme sets forth a scientific and satisfactory reconciliation of the Mosaic and Geologic records :

Days	Genesis, Chap. I.	Geology.	Geologic Ages.	
I.	Verses 2—5. Creation of Light.	Igneous Vapor, condensing.	Age of Fire.	Azoic.
II.	5—8. Creation of Firmament.	Gathering of Clouds. Descent of Rains. Earliest Sediments.	Age of Rain.	
III.	9—13. Creation of Dry Land. Creation of Plants.	Uplift of Continents. Appearance of Marine Plants.	Age of Land and Plant-making.	
IV.	14—19. Creation (appointment) of Sun, Moon and Stars.	Dispersion of Clouds. Appearance of Sun, Moon and Stars.	Age of Plant-growth.	
V.	20—23. Creation of Aquatic Animals and Birds.	Appearance of Marine Animals, (Molluscs, Fishes, etc.) and Aquatic Reptiles, Birds.	Age of Molluscs. Fishes. Reptiles. Birds.	Paleozoic. Mesozoic.
VI.	24—31. Creation of Land Animals.	Appearance of Mammals. Man.	Age of Mammals.	Cenozoic.
VII.	Gen. II.—2, 3. God rested.	Reign of Man. The Sabbath of Creation.	Age of Man.	Phrenozoic.





