

*Natural Science*

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AN ADDRESS

BEFORE

THE CUVIERIAN SOCIETY

OF THE

WESLEYAN UNIVERSITY, MIDDLETOWN, CONN.,

BY

WILLIAM H. ALLEN, A.M.,

PROFESSOR OF CHEMISTRY AND EXPERIMENTAL PHILOSOPHY IN DICKINSON COLLEGE.

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## ADDRESS.

*Gentlemen of the Cuvierian Society,*—In rising to address you and the audience favoring with their presence, I am conscious before whom I am to speak. I am to address many whose knowledge of that department of philosophy which this society is designed to promote, is far more extensive than my own; and who are infinitely more able than myself to do justice to the occasion. I need not inform you, therefore, that I stand here with no ordinary feelings of diffidence. I am consoled and encouraged, however, by the assurance that they who have advanced most deeply into the penetralia of nature, and who have been admitted most intimately to her sacred mysteries, will be most ready to extend indulgence to a votary yet in his noviciate, and most willing to excuse a tottering step in him who has but just trod upon the threshold of her temple.

It would be presumption in the pupil to arrogate the functions of the instructor. Equally presumptuous would it be in him who is now to address you to attempt the solution of some problem in natural science which has baffled the sagacity of the wisest men, merely to show how great a theme he dared to touch; or to broach some undigested theory to excite, perchance, the notice of an hour, and then to be buried with the thousands that have gone before, serving only to demonstrate the ingenious absurdity of their projectors. It were, indeed, a pleasing labor to sketch the history and progress of natural science from its early and feeble beginnings to its present colossal development. But there I perceive the footsteps of the veteran who stood in this place before me, and who spread out to your view the choicest flowers which adorned his pathway.\* It better becomes me, just entering the great garden of nature, to confine myself to an humbler sphere. My object, therefore, in the present discourse, will be to present some of the motives to exertion which are placed before the philosopher of nature, and to show the spirit requisite to success in his pursuits.

All philosophy is founded on the study of relations. The relations which exist between man and his Maker, and the duties growing out of these relations, are the subjects of theological philosophy. The relations which exist between man and man, and the duties growing out of them, are the subjects of moral philosophy. The relations which exist between man and the material world, and between all material things, are the subjects of physical philosophy. In naming these great departments of knowledge it is not my intention to graduate them on a scale of value. The importance of each and all of them is known and admitted. Theology possesses claims on human attention strong as the hopes of immortality, solemn as the sanctions of eternity, fearful as the retributions of Omnipotence. Moral science appeals to the present happiness of mankind, the order and well-being of society, the establishment and guardianship of public and private rights, the interpretation and application of natural law, the impartial administration of justice, and the regulation of human conduct in thousands of cases which statutes could never

\* See Dr. Jarvis's Address before the Hartford Natural History Society, which he repeated at the Wesleyan University.



reach; and we readily admit that "her voice is the harmony of the world." Physical science points to civilization, which she has promoted; to agriculture, commerce, and the mechanic arts, of which she is the common mother; to the accessions she has made to human comfort and convenience; to the powers of nature she has made subservient to man; and she exclaims, "These are my trophies!"

The importance and value of each of these departments of study can be fully sustained and illustrated without derogating in the least from the others. Each is indispensable in its place to complete the structure of education. If one be neglected, a base, a shaft, or a capital is wanting in our column, and the perfection of our edifice is destroyed. I hope, therefore, though my remarks to-day be confined to one class of studies, I shall not be charged with blindness to the merits of others, nor prove myself the younger brother of the insect that thought the narrow leaf on which he existed the utmost extent of the universe.

The business of natural history is to describe and classify. It leaves to chemistry the study of elementary bodies and the laws of their combination, and applies itself to ascertain the properties and relations of all the productions of nature, both organic and inorganic, just as they come from her hand. To name the extent and objects of this science is sufficient to show its importance; and before a society organized expressly for its cultivation to demonstrate its utility would seem a work of supererogation. It would hardly require argument to convince even an uninstructed man that he ought to be acquainted with the properties of those bodies, and the powers of those agents, by which he is constantly surrounded, and deprived of which he could not exist an hour. By every garment we put on, every particle of food that sustains us, every time we tread upon the earth, or open our eyes to the light,—in a word, by every breath we draw, we are reminded of our relations to the natural world and of our dependence upon it. Yet no department of science has been assailed more violently on the charge of inutility, by those men who shape every action with reference to some immediate advantage, than that which introduces man to the beings and objects around him—the glorious mechanism of the same almighty hand that created himself. Many a speculator on the capital bequeathed by philosophy, readily admits the utility of chemistry, mechanics, and astronomy; but meets the naturalist with, "Cui bono?" What! to chase a butterfly with the ardor of an urchin! to gaze with rapture on an insect or a reptile! to inspect the bird-care than the Western adventurer surveys the site of his future city! to delve for the fossil fishes of your valley with more perseverance than for a mine of gold! to preserve a petrified trilobite as the apple of your eye! to study the skeleton of the megatherium, and the locomotive or the anatomy of a steamboat! What benefit is the world to derive from the knowledge that the opossum formerly existed in France, and the elephant in America? How much richer is Europe because Cuvier spent his life in articulating the crumbling skeletons which he had rifled from nature's ancient charnel-house? Dull business this to make money. The man whose only divinity is mammon, and who deems nothing useful or beneficial that does

not cater for his appetites, or pander for his passions, natural history allures with no golden bribe. Let such men grovel. There are studies worthy of our pursuit for themselves alone—studies which elevate men above considerations of sordid interest, and which surround them with the elements of a new world. To him who is imbued with a philosophic spirit, the contemplation of truth is a sufficient reward of toil. He loves knowledge for its own sake. He claims the same right as others to pursue and enjoy what is to him the highest good. And if men who can appreciate neither his labors nor his motives approach to question or brand him as the votary of unprofitable pursuits, he can retire within himself, wrap himself around with the mantle of his own thoughts, and say, "Procul. O procul este, profani."

The spirit of the old philosophy was selfish and exclusive. To use a favorite expression of our times, it was aristocratic. Having little sympathy with the mass of men, it sought rather to secure a blind veneration for its disciples than to promote the convenience, the comfort, or the improvement of the human race. It labored to make the few more than men, while it left the many less than men. The rival sects of the Greeks and the schoolmen of the middle ages wasted their great powers in subtle and endless speculations, and contributed little substantially useful to the world. Plato contemned the herd of vulgar geometricians who condescended to apply mathematical truth to practical purposes, and deemed the science degraded by such slavish and sordid applications. The Roman Seneca was indignant that philosophy had received the insulting eulogy of having assisted in the progress of some of the useful arts; and disdained to dignify with the appellation of philosophers men who happened to be guilty of mechanical inventions. Even Archimedes considered patriotism hardly an adequate apology for stooping from his loftier abstractions to construct those engines for the defence of his city which excited the astonishment of mankind.

On the contrary, the new philosophy, of which Lord Bacon was the founder, is decidedly democratic. While its object is truth, its spirit is philanthropic and diffusive. It looks to the elevation of the whole human family. It seeks so to apply every new truth that men shall be better off for its discovery. Now like most democracies this democratic philosophy has run into some excesses. Because Bacon taught a philosophy which has subverted the interests of the multitude, the multitude now clamor against all philosophy whose utility is not visible, tangible, and immediate. There is a strong tendency in the present age to elevate utility above the love of truth, the subaltern above the superior. The spirit of the Baconian philosophy is misapprehended. Its end is truth; and though it believes whatever is true is useful, and useful because true, yet it pursues truth, not because it is useful, but because it is true.

Were we permitted to yield so far to the spirit and prejudices of this age as to advocate the study of natural history from considerations of utility alone, there would be no "lack of argument" in its favor. We might point to every pharmacopœia, filled with the contributions of botany to medicine. We might point to the animals which have been domesticated; to the fruits and vegetables for the sustenance and clothing of men which have been transplanted and successfully cultivated far from the soil to which they were indigenous; and to the beds of coal, the veins of valuable ores, and the



quarries of marble, granite, slate, and other building materials which have been discovered by the aid of this science. It has literally fed the hungry, clad the naked, warmed the shivering, and healed the sick. Equally with mechanics, chemistry, and astronomy, it has contributed its share toward the advancement of those useful arts which, by supplying the increasing wants of men with diminished labor, afford them the time and the means for mental improvement. For though every man who practices a useful art does not necessarily understand the science on which it is based, yet the development of the law by the man of science usually precedes the application of the principle by the man of business. To illustrate: every builder does not understand the principles of architecture. An apprenticeship has taught him to imitate his models and move in the beaten track. But who gave him his models? Who struck out the lines of beauty, fixed the proportions of symmetry, and from the ideal fabric in his own mind reared the perfect structure for the builder to imitate? The veriest blockhead of a druggist's boy can now make matches that will kindle by friction; but did he perform so easy a labor who discovered the phosphorus in which they are dipped? Many processes perfectly simple and plain when once known, cost wearisome toil and patient thought to discover. Any navigator can now make a voyage to America. It required a Columbus to make the first.

Again: the conditions of our own existence, the structure and organization of our bodies, the influence of natural agents on our health and life, and the consequent importance of temperance, exercise, regular habits, fresh air, proper food, drink, sleep, clothing, and shelter, constitute a branch of physical knowledge intimately connected with our well-being in this life. Does any one, running, like the ancient sages, from utilitarianism to the opposite extreme, pronounce these matters of trivial moment, because they directly affect our bodies only? To eat, drink, dress, and sleep, are, we admit, rather vulgar employments; but we cannot survive a single week without them. So long, then, as they are indispensable to our existence, is it a small matter that they be properly done? Facts abundantly prove that, as a general statement, when the body is in health the mind is active and vigorous; but when diseased, the mind sympathizes with it, droops, and languishes. If, then, the highest state of mental efficiency is usually found connected with the most perfect state of physical health, it follows that whatever injures our physical health will also diminish our mental efficiency. But a knowledge of our relations to the material world assures us that nothing so soon affects our health as the improper performance of those acts of daily recurrence which our own comfort and the desire of self-preservation oblige us to perform. He, therefore, who would preserve the powers of his mind in health and strength must attend to these vulgar things. If he do not, the neglected tenement will be shattered and tumble into ruins, and the occupant will be crushed beneath the wreck. He has violated the conditions on which health and life are granted; and though his error were the error of ignorance, and not of design, he must pay the penalty of the infraction. In this manner how many whose anticipations once were bright, who gave ample promise of becoming ornaments of the age in which they lived, of adding something to the amount of human knowledge, and of enrolling their names among the benefactors

of mankind, withered from the earth in the very beginning of their career! I will cite no example. To many present all aids of remembrance were unnecessary and obtrusive. Suggestion to them is more eloquent than language. You need no example so long as from beneath yonder marble monument "where sleeps the loved and lost of earth," comes forth a silent voice to attest the truth of my words.\*

Few perhaps would be disposed to question these general statements as to the utility of physical studies, but if we descend to the minuter details of science, objectors multiply. To devote a life to the examination of a single class of insects or plants which are apparently valueless, or to the study of the structure and habits of microscopic animalculæ, seems to most men an enormous waste of time. But who, I would ask, is to decide what may or may not prove useful hereafter? A discovery unimportant in itself may be the thread that shall guide to another, of inestimable value. To the true philosopher nothing is trivial. The oscillations of a chandelier led to the invention of the pendulum, and the fall of an apple to the discovery of the laws of gravitation. Even the pursuit of a visionary object may lead to important practical results. The alchemists for many centuries tantalized the world with delusive hopes of exhaustless riches and universal health. Though they failed to satisfy the expectations of cupidity, they were the inventors of useful apparatus, the discoverers of powerful agents, the fathers of experiment, and from the ashes of their exploded science modern chemistry has sprung.

While a science is yet progressive, and before its more remote and hidden relations have been traced, so far is the world from being able to judge of its utility, that the philosopher himself can seldom appreciate the full importance of his own labors. Little did the first observer of the properties of loadstone imagine that same attractive influence would afterward be used to direct the mariner on the ocean and the wanderer in the desert. The discovery of the properties of steam was apparently a matter of small consequence; but mark the applications of this knowledge in our age. Galvani observed that the contact of silver and steel produced contractions in animal fibres. Volta succeeded in developing the new agent in sufficient quantities to produce surprising results on the human system. Davy applied the same agent to deflagrate the most refractory bodies, and to overcome the most obstinate affinities. Oersted discovered its power to deflect the magnetic needle, and to magnetize the conductors along which it passed. Succeeding philosophers have developed the laws of electro-dynamics, and applied the principles of electro-magnetism to the production of rotary motion. Think you Galvani dreamed that his discovery was the first step to so magnificent results? Dare we, even at this day, assign limits to the benefits mankind may yet derive from it?

One more example, drawn from another department of science. The immortal John Kepler was regarded by his contemporaries as an enthusiast, wrapped up in futile dreams about the celestial harmonies, raked from the ashes of the Pythagorean philosophy.—Without friends, without assistance, without sympathy, chilled by poverty, and emaciated by hunger, he toiled on in his abstruse

\* Aaron H. Hurd, of Reach, Upper Canada, who died at the Wesleyan University, in 1836.



investigations. Mark him at his midnight study. The agony of intense thought is thrilling along his trembling nerves. Anon a ray from the light of truth darts through the shadows of doubt that envelop his mind, and see how his eye flashes with unearthly joy! how his breast dilates with excessive emotion! Hope renewed, still on he toils. Look again. The day is dawning. The morning twilight streaks the east. The clouds of uncertainty vanish from his mind, and truth's bright sun pours a full blaze of light upon his soul. He starts up in transport, and exclaims, "Nothing can restrain me; I yield to the sacred phrensy; I have stolen the golden vessels of the Egyptians, and I will build of them a tabernacle to my God." He has written a book—a book which he knows the coming generations will read, though it fall unnoticed upon his own. He is content "it should wait a century for a reader, if God had waited six thousand years for an observer."\* And long after the sublime soul of Kepler had fled from the discordances of earth, to listen in heaven to the harmonies of the spheres, his book did find a reader. Newton rose, and the *three laws of Kepler*† were the basis on which he reared his own stupendous fabric.

If an apology is necessary for devoting so much time to the discussion of utility as a motive to exertion in scientific pursuits, it may be found in the tendencies of our own age and people. My aim has been to give the motive due consideration, but to hold it always subordinate to the love of truth. In the breast of the real philosopher truth holds an empire whose throne no aspirant can usurp. In her revered presence he breathes a purer atmosphere, and is illuminated with a clearer light. When he has discovered a new fact, or a new law, he feels that he has approached one step nearer to that infinite intelligence which he can never reach. But the feeling is not one of pride or self-exaltation. At every step of his advance he has a wider view of the immensity of that untrodden space which still separates him from Omniscience. He regards the laws of nature as the Creator's modes of operation in the material world. The study of nature, then, is the study of God, and the knowledge of his relations to the material world is the knowledge of his physical relations to the great Author of all. Humility and awe penetrate and pervade his soul as in the palpable presence of Divinity.

Another class of motives to physical studies is drawn from the beneficial effect of these studies upon the mind. And allow me here to remark, these motives address themselves with peculiar force to young men whose mental and moral habits are not yet perfectly formed, and to those, if any be present, who are still hesitating as to their future pursuits, and the kind of mental training suited to the work of preparation. In this connection I shall briefly consider the influence of the study of nature, first, upon the intellectual, and, secondly, upon the moral character.

That formation of intellectual habits usually called mental discipline is more important to the scholar than the actual amount of

\* Si ignoscitis, gaudebo; si succensetis, feram; jacio in aleam, librumque scribo, seu presentibus, seu posteris legendum, nihil interest; expectet ille suum lectorem per annos centum; si Deus ipse per annorum sena millia contemplatorem præstolatus est.—*Harmonices Mundi, Præmium*, lib. v.

† *Regulæ Kepleri*. 1. The planets move in ellipses of which the sun is in one of the foci. 2. The radii vectores describe equal sectors in equal times. 3. The squares of the times of revolution of the planets are as the cubes of their mean distances from the sun.

knowledge acquired during a course of study. This discipline is the foundation on which he is to erect his superstructure. It enables him to pursue, by his own unaided powers, any science, and to investigate any subject to which he may apply himself in future life. It teaches him to command his attention, to concentrate his strength, and to remove the obstacles he meets with by patient reliance on his own resources. Doubtless every department of study, rigidly and faithfully pursued, is favorable to this discipline. But the science of nature seems peculiarly adapted to the cultivation of those habits of thought and reasoning which fit men for the duties and emergencies of this plain, matter-of-fact world in which they live. It is a science in which the most perfect order, method, and system prevail; and which deals in realities, rather than abstractions and hypotheses—in things which are, rather than things which might be, or which we imagine ought to be. It exercises the faculties which men have most frequent occasion to employ in the affairs of life. Attention, memory, judgment, and the powers of analysis and classification, it calls into constant and vigorous action. It suffers us not to indulge in speculative vagaries, which

"Lead to bewilder and dazzle to blind."

Its logic never teaches sophistry for reasoning, nor permits us to contend for victory rather than truth. In fine, if careful observation of phenomena, diligent collection and collation of facts, accurate delineation of properties, bold induction and far-reaching generalization can prepare the mind for noble achievements, then, without question, the man who has studied and understood the relations established by the Creator in the natural world, will be most competent to trace and illustrate the laws impressed by the same Being on the world of mind and morals. The science of mind is yet brooded by the incubus of scholastic philosophy. And if MIND is ever to be extricated from the labyrinth of logomachies which have been piled above and around her, NATURE must furnish the thread that shall guide her to the light.

I have condensed my remarks on the influence of physical studies upon the intellect, that I might have a more reasonable claim to your indulgence while I dilate more upon their moral influence. If we examine the lives and character of men eminent in natural science, we shall find them, with rare exceptions, conspicuous for moral integrity. In Linnæus, in Werner, in our own lamented Godman, and in many others who have made the study of nature the business of their lives, we are charmed with a simplicity of manners, a kindness of heart, a purity of sentiment, an elevation of principle, and an integrity of purpose, which seem to have been nurtured and matured by the pursuits to which they were devoted. There is in these studies an innocence, a silent, unobserved, but constant influence, which purifies the soul from the gross and sensual, and surrounds it with a healthful moral atmosphere. The habits of mind formed by contemplation of the order and harmony of nature readily extend to the observance and love of those moral harmonies in which virtue consists.

After the love of virtue, the next strongest restraint from vice is the fear of punishment. Though a man have no desire to practice virtue for her own sake, if he understand the laws of his physical being, he knows that every violation of these laws will be followed,



sooner or later, by inevitable and severe retribution. It is just as certain that habits of licentiousness, intemperance, or excess of any kind, will introduce derangement into the physical economy as that a dose of arsenic will cause pain and death. But he who is ignorant of those laws may give loose reins to passion and appetite, and if he escape present suffering may think he is safe. He knows not that from the seed he is now sowing will spring up, as from the fabled dragon's teeth, an armed host to torment his advancing years. He rushes on blindly, and therefore has nothing to restrain him. The man of science, on the contrary, when perhaps no principle of moral goodness would be strong enough to deter him, might be held back from ruin by his knowledge that the day of reckoning, though late, must come.

Again: the principle of curiosity is a part of our constitution, and its moral tendency depends on the character of the objects of its gratification. Directed to frivolous or vicious objects, its perverted strength becomes a fearful instrument of moral desolation. Its victim listens to the tongue of slander, and forthwith his own drips with the same venom. He enters among scenes of expensive amusement and corrupting pleasure. He looks on vice to assure himself of her deformity, and then clasps her to his familiar bosom. Over every new form of wickedness and crime the morbid principle gloats with insatiate delight. But nature, from her varied storehouse, can furnish aliment to keep curiosity ever active, yet ever healthy. Is it pleased with simple and quiet beauty? The rivers, the groves, the fields, and hills teem with unnumbered objects for its innocent gratification. Does it love the grand and the terrific? The tornado, the earthquake, and the volcano will satisfy it. Does it seek the new and the romantic? The vast volume of entire nature is a novel that never cloy; and whether we view the skill of the plot, the variety of incidents, the fitness of the arrangement, or the beauty of the illustrations, we find the book unsurpassed and inimitable. Does curiosity delight to roam with the antiquary among the monuments of ages past? Nature reveals wonders older than man himself. And if there is a noble pleasure in examining coins and medals, deciphering inscriptions, and surveying ruins, which are the only authentic annals of some remote age and country, how much nobler to read the hieroglyphics imprinted on the everlasting hills by the finger of God himself! to study the wrecks of ancient worlds, the relics of organic bodies, which, long before "man was seen walking with countenance erect," filled the air, the earth, and the waters with the hum of joyous life, the voices of love, and the conflicts of carnivorous belligerents! Champolion sought the secrets of four thousand years in the tombs of buried Pharaohs; but the sublimer genius of Cuvier untombed and translated the records of the world, compared with which the learning of Egypt was a bawble of yesterday; and

"Backward to the birth  
Of time itself adventurous trod,  
And in the mingled mass of earth  
Found out the handiwork of God."

Curiosity delves in the ashes of Pompeii and Herculaneum for specimens of ancient art and illustrations of ancient customs. But in the study of nature it has a wider scope; to unbury the history of extinct races of animated beings, and to trace the gradual progress of this residence of man from its primitive chaos to order,

consistence, and solidity. Curiosity numbers the broken columns of the Parthenon, measures the dimensions of the Coliseum, and admires the sculptured relics of Phidias and Praxiteles. But nature shows the grander architecture of the mountains and the bolder sculpture of the rocks. Do men admire the power and perseverance that reared the massy pyramids, and will they not ask what mighty force rent asunder the crust of the globe, and upheaved mountains, islands, and continents from the bed of the primeval ocean? In contemplation of such a succession of existences and convulsions we feel that man is indeed "of yesterday, and knoweth nothing." We seem to wander through eternity, to explore the secrets of creation, yea, almost to hold converse with the "Spirit of God moving upon the face of the waters."

The study of natural science is also favorable to virtue, because it opens to the aspiring a safe path to honorable reputation. The desire of distinction, so strong in most men, if directed to proper objects, and restricted within the necessary bounds, is certainly right and commendable. A writer whose political career has excited much more notice than his poetry, has said,—

"Teach not your children then to shun ambition,  
Nor quench the flame that must for ever burn;  
But, in the days of infancy, their vision  
To deeds of virtue and of glory turn."

This principle of action, however, often leads through devious and dangerous roads. The prize is sought by some in the mad schemes which agitate and paralyze society; by others, in the clamors of party strife, in the fierce conflicts for political aggrandizement, and in the perilous struggle for military renown. But all these paths are thickly set with snares; and few, very few pass through them unscathed. Even literary pursuits have wrecked the morals of many a brilliant genius, and left melancholy monuments of perverted talents. Before a young man rushes into the midst of temptation, and, boastful of his fancied strength, deems that virtue worthless which has been nurtured where no motives to forsake her are confronted, he well may pause.

But in the study of nature the aspirant for distinction meets few temptations to deviate from moral rectitude. Here he may attain his end without sacrificing integrity to selfishness. Here he need not fear to be honest, lest he should not become honorable. Better would it be for the young men of our country, and for our country itself, were they less eager to plunge into the whirlpool of politics and speculation. There the race is not always to the swift, nor the battle to the strong. He often wins who makes the most irreparable of all sacrifices to his object—the sacrifice of principle. But here merit is sure of its recompense—a recompense, too, unsullied by the shadow of remorse. There, if success attend him, he will sit on those tarnished seats of honor to which, perhaps, a reptile has wormed his tortuous way before him, and where he must feel degraded as a man by the measures he is compelled to advocate as a partisan. Here he can walk erect in the proud integrity of virtue, gain a name more enviable than the civic crown of the modern demagogue, secure pleasures which wealth can never purchase, and reap rewards compared with which the soldier's laurel, reeking with tears and blood, withers and fades.

An objection has been sometimes urged against physical studies,



that they lead to infidelity; and a catalogue of the names of infidel philosophers has been arrayed to support the charge. To this it may be answered, if the question is to be settled by the authority of names, the charge can be easily met. For every name of an eminent natural philosopher who has rejected Christianity, we can produce two equally eminent who have embraced and defended it. The argument, however, seems to be defective. When it is alleged that certain philosophers were unbelievers, unless it can be proved that their favorite studies made them so, we cannot infer that the same studies have a tendency to make others so. But where is the proof that the pursuit of physical studies was the cause of unbelief in any one of these philosophers? If the argument prove any thing, it proves too much. Let us apply it to other cases, and see to what it would lead. It was stated a few years since that all the professors of theology in a celebrated German university were infidels: therefore theological studies lead to infidelity! Unbelievers have been found in every department of philosophy: therefore all science leads to infidelity! If to correct the gross ideas entertained by many of God, his attributes, and his works, and to eradicate superstitious and ridiculous notions from the minds of men, lead to infidelity, then indeed these, in common with all liberal studies, do lead to infidelity. Science has certainly uprooted many absurd and foolish opinions, and made men rational on a variety of subjects. Superstition once saw in the secret arts of magic the agency of invisible demons. Science has exhibited the same phenomena, and given their simple and obvious rationale. Superstition regarded thunder as the rumbling of the chariot wheels of Jupiter careering in the clouds and hurling his bolts upon the affrighted earth. Science has shown that this sound is produced by the concussion of the air after the passage of the electrical discharge. Superstition looked upon comets as the terrific harbingers of impending calamities. Science has shown them to be harmless as the planets, and obedient to the same laws. Superstition saw in the aurora borealis the conflicts of embattled armies, the flickering of crimson swords, and "garments rolled in blood." Science declares this phenomenon to be caused by the passage of diffused electricity through the rarefied regions of the atmosphere. Superstition believed the earthquake portentous of wrath, when Olympus trembled beneath the rod of its despot. Science demonstrates that it is caused by the operation of subterranean agents, in accordance with chemical laws. But while science refers these phenomena to natural laws, she teaches men to stop not here; to look beyond secondary causes to the great First Cause of all—the Being who spoke these laws into existence, and impressed them on the material world. If

"The undevout astronomer is mad,"

how much more is that man mad who can contemplate the great order of universal nature, the unerring regularity and uniformity of her operations, and trace the evidences of design and intelligence through

"Beast, bird, fish, insect, what no eye can see,  
No glass can reach,"

and still deny the existence and government of a supreme and all-creative God!

Another reason why science is charged with leading to infidelity

is the apparent incongruity sometimes found to exist between its conclusions and certain passages in the Holy Scriptures, as generally explained and understood. Galileo was immured in the dungeons of the inquisition for asserting the truth of the Copernican system, because that system was supposed to be incompatible with revelation. Yet the earth moved on!\* Hutton, Leslie, and Playfair were assailed with all the virulence of prejudice for declaring that the earth must have been created "in the beginning," and not six thousand years ago, when man was placed upon it. Yet now many eminent theologians in Europe and America are foremost in asserting the same. It does seem that the triumph of the Copernican astronomy over the bigotry of the Romish Church, and the more recent triumph of the modern geogony, might teach men the folly of arraying a preconceived construction of language in opposition to the established truths of science. To take alarm at every new discovery, lest it controvert some popular interpretation of the sacred record, shows for religion a "zeal not according to knowledge." Truth is always consistent with itself. A truth in natural science can no more contradict the revelation of God than God can contradict himself. And still more, a truth in science, once demonstrated, as peremptorily challenges belief as the voice of the Almighty from the thunders and thick darkness of Sinai. Nature and revelation go hand in hand; and each rightly understood becomes an unerring commentary on the other. When the expounders of the Bible shall have learned how far its language is to be construed according to the exact letter, and how far it conformed to the state of human knowledge at the time it was delivered, no inconsistency will be found between the sacred volume and

"That elder scripture writ by God's own hand."

The last class of motives to the study of natural science which I shall notice, is drawn from the desire felt by every patriotic American to promote the reputation of his country. The firmest basis of a nation's honor must be laid in the minds of its people. We would see the land of our birth and our affections rising as rapidly in scientific fame as in wealth and political power. Yet we know that the genius of our institutions forbids us to expect from the general government any direct assistance in those pursuits which, being productive of no adequate emolument, most of all require liberal patronage. The monarchists of Europe have declared our institutions hostile to all such pursuits, and have confidently predicted our utter neglect of them. Now as lovers of our country and its system of government, does it not behoove us to show to the world that "*men constitute a state*;" and what kings, princes, and nobles can do in Europe, *men* can do here?

We could, indeed, wish our government more disposed to countenance scientific men and scientific pursuits. We could wish to possess a national garden of plants and a national cabinet of natural history which should rival even those of Paris. But so long as government is the creature it will be also the instrument of the people's will. When the popular mind shall have been instructed, and the popular taste rightly directed, the public voice will demand what

\* "*E pur si muove*," were the indignant words of Galileo after he had been compelled to pronounce the prescribed formula of abjuration: "*Corde sincero et fide non fictu abjuro, maledico et detestor supradictos errores et hereses*."



now it would reject. Thus to change the people's will must be the work of time and patient perseverance. At present, as heretofore, the advancement of natural history must depend on the efficiency of individual exertions. If the speedy dissolution of great estates among us, in consequence of the abrogation of the laws of primogeniture, will not permit single individuals to exercise princely munificence, it enables a much greater number to contribute with generous liberality. Combination, therefore, must accomplish in America what patronage has done in Europe. The numerous associations which are springing up in every part of our land for the cultivation of natural history are scattering their influence over the whole face of the community. And we need not despair of seeing in a few years multitudes of farmers, miners, seamen, and soldiers, and even the hunters of the Rocky Mountains, as well as the more liberally educated classes of engineers, travelers, and military and naval officers, so far interested and instructed in this pleasing science as to be induced to preserve the specimens which they have so many opportunities to procure.

The success of the cultivators of natural history in our country, for a few years past, affords most cheering encouragement for the future. Even so late as the close of the last war how few were the laborers in this broad and fertile field! Yet they sat not down in hopeless inactivity. The magnitude of the work to be done nerved them with greater strength. They yielded to no difficulties, and shrank from no sacrifices. Would you see the results of their labors? Look abroad over the land, and they will meet you in every respectable college, in every populous city, even in many small towns and private houses. Many of the states have contributed much to science by directing geological surveys within their limits, and in some cases these surveys have extended to all departments of natural history. Even the general government has exhibited an occasional though hesitating disposition to promote, as far as its limited powers will allow, the same great objects.

Among the early pioneers of natural science in this country a neighboring venerable institution in your own state can boast one of the most persevering and most successful. The American Journal of Science and Arts, undertaken with dubious auspices, and prosecuted with disheartening sacrifices, has done more for the cause of science in our country than can be well estimated. This rich depository of valuable intelligence, this table-companion for every scientific American, is an imperishable monument of the industry and rare ability of its learned editor. I should do injustice to the feelings of gratitude which flow spontaneously from a pupil to an accomplished and revered instructor, should I not also mention in this connection the name of Professor Cleaveland, who published the first edition of his *Mineralogy* in 1816. This, with the subsequent enlarged and improved edition, gave a new impulse to that science in this country; and the estimation in which the work is held is best shown by the clamorous importunity of the public for a third edition. In other departments of natural history brilliant lights soon arose. Though cut off in the midst of his unfinished labors, Dr. Godman has left, in his *History of North American Quadrupeds*, a noble specimen of what might have been expected from his maturer researches and later studies. And more recently Mr. Audubon, by his admirable *Biography of Birds*, has placed

himself in the first rank of ornithologists: The labors of these men, and of many others whom the limits of this address will not permit me to name, have rapidly diffused a spirit of inquiry and a correct taste on these subjects. They have allured many ardent disciples into the same paths. They have laid the foundation of an enduring reputation, both for themselves and their country. Americans are learning from them what they have to do, what they can do, and how to do it. And while we are ever ready to award merited praise to scientific foreigners who labor among us, we are resolved to be no longer dependent upon them to explore our mineral wealth, and to describe and classify our plants and animals.

I have thus, gentlemen, very imperfectly, I am aware, presented for your consideration three classes of motives to exertion in the study of natural science, and more particularly of natural history: 1. The motives drawn from considerations of utility; 2. From the intellectual and moral influence of these studies; 3. From their bearing on the reputation of our country.

It now only remains to show the spirit by which the philosopher of nature should be impelled in the prosecution of his objects. Let no one who enters this delightful path hope to be released from the conditions on which all knowledge is gained. It was a remark of the wise Socrates, "The gods have given nothing valuable to men without great labor." On this subject the wisdom of antiquity has not yielded to modern innovation and improvement. In no department of learning has a railroad yet been constructed. If we trace the of locomotion can whirl us to the desired goal. If we trace the history of those lights of science which have shone most conspicuously in the fields of original discovery, we shall find they owed their success to an ardent love of their pursuits, to a noble disregard of self, and to firm purpose and resolute exertion. 'I would say, therefore, that the spirit of the naturalist should be a spirit of perseverance, self-devotedness, and enthusiasm. He must see no other object of ambition; he must be allured by no other enchanter. To the end in view he must not only cheerfully but exultingly devote his time and his talents, and, next after the preparation for an immortal state, must make it the business of his life. The great Linnæus, in pursuit of botanical knowledge, traversed on foot the frozen mountains of Lapland; and in England fell on his knees in ecstasy at sight of the golden bloom of the furze of Putney heath. "Dr. Godman," observes his biographer, "has been heard to say, that in investigating the habits of the shrew mole he walked many hundred miles." The same writer also says, "His eagerness in the pursuit of knowledge seemed like the impulse of gnawing hunger and unquenchable thirst. Neither adversity nor disease could allay it." Mr. Audubon, in preparing his splendid work upon ornithology, has evinced the same zealous enthusiasm and the same indomitable perseverance, whether we follow him under the broiling sun of Louisiana, or over the vast prairies of the western wilderness, or amid the rocks, and ice, and desolation of the Labrador coast. Speaking of Wilson's great work on the same subject, Dr. De Kay remarks,\* "The peculiar disadvantages under which Wilson labored would have dampened and discouraged any spirit but his own. His ardent enthusiasm for his favorite pursuits, and his noble disdain of the most appalling obstacles, are finely exhibited in his reply to a

\* See Dr. De Kay's Address before the New-York Lyceum of Natural History.



friend who endeavored to dissuade him from the publication of his work, 'I shall at least leave a beacon to show where I perished.'"

Such, gentlemen, are the models for the imitation of the naturalist who would strive for eminence or hope for success. Such is the enthusiasm he must feel; such the devotedness with which he must render himself to the work; such the spirit that must dwell and reign within him.

A recent youthful but ingenious writer has compared science to an immense horizontal column, which successive generations of philosophers are raising to a perpendicular position. The first rear it as high as they can reach, and leave it so. Their successors, to lift it higher, must be taller and stronger men than themselves; and every succeeding generation must surpass the last, or the column can never go up. Were this a true simile, the prospect of the successors of Davy and Berzelius, Laplace and Lagrange, Herschel and Cuvier, to heave the column any higher must be alarmingly dubious! The comparison, however, will not hold. The truth is, every succeeding generation of philosophers stand on the shoulders of those who went before them. Though they be only equal in stature, they still overtop their predecessors, and push up the column a little higher. We begin where our fathers ended. We have the benefit of their labors and discoveries. They are the pillars which support the stage we stand on. They place in our hands the instruments to work with; and we go on toward the accomplishment of the labors they commenced.

Let no man, therefore, sit down disheartened, and persuade himself that all has been done which can be done. It is not so. There are yet crowns reserved for him who is willing to practice the limb and strain the muscle. The boundless fields of nature have not yet been all explored. Many a wide tract still invites. When the gigantic mind of Newton compared what he had done with what he had left undone, he declared he had only "picked up a few pebbles on the shore of the great ocean of truth." Have we then the presumption to think its remotest limits have been explored? The earth, how little has she yet revealed of her deeply hidden and exhaustless treasures! But we penetrate a few hundred feet beneath her outermost crust, and dream we have displayed the secrets of her capacious bosom. The sea, what wonders hitherto unseen are stored in her profound abysses! Yet we glide over her surface, and vaunt ourselves her lords. The atmosphere, how little do we know of its tornadoes and its meteors, its changes of pressure, temperature, and moisture, and the other processes of its etherial laboratory! Yet we ascend a few miles in a balloon, and arrogate to ourselves the fabled dominion of Jupiter! How imperfectly do we understand the nature and connection of those powerful and mysterious agents, heat, electricity, and magnetism! Yet we construct an electro-magnetic engine, and proclaim nature the handmaid of our will! How many links are yet undiscovered in the great chain of being! But we flatter ourselves that the Flora, the Sylva, and the Fauna of the world are almost complete. The abstruse problem of reason and instinct is yet unsolved. The great question, "*What is life?*" is yet unanswered. But I forbear. It is at least a sufficient cause of humility to perceive how much less extended is the catalogue of our knowledge than the catalogue of our ignorance. The former can easily be told; the latter we have not even knowledge to make out.



