The Outskirts of Physical Science

Dale

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very respectfully
from the Author.

THE

OUTSKIRTS

OF

PHYSICAL SCIENCE.

Essays, Philosophical and Religious,

BY

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THE OUTSKIRTS OF PHYSICAL SCIENCE.

PREFACE.

THERE are a number of subjects which, although not within the domain proper of the physical sciences, invite the attention of the student of nature. These are the outskirts into which he is often tempted to wander, either to widen his knowledge and sympathies or to enable him to answer intelligently the questions of others. These essays are the results of a few such wanderings. They are the outgrowth of an early fondness for the study of natural science, and of religious convictions equally strong, bound to each other by that desire for unity and harmony which belongs to every seeker after truth.

These tentative papers would embody at least the spirit which should characterize comprehensive treatises on the same subjects. The first three have been printed separately during the past few years for private circulation. Because they have

interested a few, it has been supposed that, in a revised form, they might prove acceptable to a somewhat larger circle. The rather numerous and, in some cases, lengthy quotations are, it is believed, pertinent and important; and it is hoped that the thread of original matter which connects them will be found strong enough to hold them together.

The essays present briefly the more important relations of the sciences of nature to faith, education, the Bible, and religious science respectively.

NEWPORT, R. I., 1883.

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THE HARMONY

BETWEEN

CHRISTIAN FAITH AND PHYSICAL SCIENCE.

TO CHRISTIANS AND NATURALISTS.

"*Where wast thou when I laid the foundations of the earth? declare, if thou hast understanding.*" — JOB xxxviii. 4.

"*His Son, whom he hath appointed heir of all things, through whom also he made the world* (*ages*)." — HEB. i. 2.

SOME thoughtful minds, who hold enlightened views as to the *essential* harmony of religion and science, do not always discern the *method* of that harmony. It will be readily granted that a profounder knowledge of both theological and physical science,* and a broader apprehension of the spirit and the sphere both of revealed religion and of science, have enabled them to obtain a clearer view of that harmony. Their loyalty to common-sense has also greatly aided them.

While comparatively little difficulty is thus experienced in recognizing the essential harmony of religion and science, the method of that harmony is as yet far from being fully understood in such questions as those of the Bible cosmogony and chronology, the deluge, the origin of languages, and of man himself. These

* The term "physical" is generally used in these essays in contrast to the term "metaphysical."

problems involve nearly all of the sciences, and such questions in theology as: In what sense and to what extent are the Scriptures inspired? How far were they designed, if at all, to reveal other than religious truth? What principle governs the treatment of natural causes in the language of inspiration? And to what extent is the language of the Old Testament to be regarded as allegorical? Such problems are so vast in their scope, and of such intellectual and religious consequence, that an exposition of them which would satisfy both the highest theological and scientific intelligence, as well as the best Christian sense of the day, would require more than a lifetime of profound, catholic, and Christian study. Indeed, it may be said that the whole question of the relation of the natural to the supernatural, unsearchable as it is, is involved in these problems.

While these fields of study are so vast, and beset with so many difficulties, there is a smaller field, where not only the fundamental harmony between religion and science may be satisfactorily and briefly shown, but where also the method of that harmony may be viewed with the eye of a loving and intelligent faith.

It is that given in the title of this paper. While many of the questions between religion and science are largely of a speculative character, this one is very practical in its bearing; for the disastrous effect of a Christless science upon men renders Christians suspicious of science, and the fatal effect of an unenlightened faith upon science deafens the ear of the mere scientist to the appeal of evangelical Christianity, and impels him to seek to satisfy his spiritual nature with mere intellectual nourishment.

Avoiding theological language, by *Christian Faith* is to be understood simply that filial attitude of the soul towards its Creator which is made possible by the loving sacrifice and mediation of Jesus Christ, and is brought about in various ways by the gracious influence of the divine Spirit.

We might stop here to consider at length the state of a man in such an attitude. It will be sufficient, however, to say that a man so disposed toward God is in a state of increasing harmony with himself physically, intellectually, and morally, as well as socially with his fellow men as far as in him lies, and above all with the benevo-

lent character and will of his Maker. His complex being is brought under the gentle dominion of the precepts of Christ, and all his faculties gradually enter into their normal relations, and fulfil their appropriate offices. Coleridge thus describes the effect of Christian faith: "Never yet did there exist a full faith in the divine Word, by whom light as well as immortality was brought into the world, which did not expand the intellect, while it purified the heart; which did not multiply the aims and objects of the understanding, while it fixed and simplified those of the desires and passions."

While the Christian enjoys the holy freedom implied in a filial relationship to his divine Parent, the giver of physical as well as moral law, and his mind and heart are expanded by his new hope, he looks upon Nature with new interest. He intuitively recognizes God as her maker, and sees in her the workmanship of God. He soon learns to praise God in His works. The evidences of divine wisdom bring to his mind the evidences of divine goodness. He may know little or nothing of the system of forces and laws by which God has fashioned the

world, and brought it to its present state of perfection and beauty, — that is, *how* God made it, — but he knows that *somehow* God did make it, and that this God is his Father in heaven. When the soul first beholds Nature in the light of the cross, then does it indeed realize and enjoy her beauty. With a conscience relieved of its burden, the soul united forever to its divine source and object, in harmony with itself and with Nature, looks upon her with a sense of fellowship; for it perceives that both nature and the spiritual life are from Him, and it finds the moral order and beauty within, responding to the physical order and beauty without.

With this spirit the Psalms abound. Some of them were evidently written by persons who not only communed with God, but were also intimately acquainted with external nature. It is interesting to note how fully Alexander Von Humboldt appreciated the truthfulness and grandeur of their descriptions of nature. Would that the great naturalist had told us as plainly that he loved their religious import also. He says: "One would say that a picture of the whole cosmos is exhibited in the 104th Psalm. One is surprised to

find the universe, heaven and earth, portrayed in a few great outlines in a lyric poem of so small a compass. Here the quiet, painful toil of man, from sunrise until the end of the day's work in the evening, is contrasted to the moving, elemental life of nature. This contrast, the universal conception of the reciprocity of phenomena, this regard to an omnipresent, invisible Power, able to rejuvenate the earth or grind it to powder, constitutes the solemnity of a poetical composition which is less warm and tender than sublime." *

The closing chapters of the venerable Book of Job contain descriptions of nature matchless for their simplicity and fidelity. The passing cloud, the timely rain, the snow, thunder, whirlwind, storm and sunshine, day and night, the adjustment of seas and continents, the mysteries of life and death, the procession of the stars, the multiplication of animal life, the instincts of the wild ass, the ostrich, and the war-horse, the strength of the wild ox, the hippopotamus, and the crocodile, and even the colors of the peacock's feather, — all there teach to the proud and discordant spirit of

* Kosmos, Vol. II. pp. 46, 47.

man a lesson of the wisdom and power of God as revealed in the adjustments, the adaptations, the intelligences, the orderliness, and the beauty of nature.

We have the words of our Lord himself contrasting the beauty with which God clothes a flower with the pomp of human art; and it is safe to assert that devout admiration of God's works has characterized the more intelligent and pious of God's children in all times and countries; and what mortal spirit has not sometimes in Nature's presence felt its better elements silently stirred and appealed to?

Physical Science may be briefly defined as that science which has primarily for its object the intellectual subjugation of Nature in order that she may become the intellectual possession of man, independently of the possibility of that knowledge being made to contribute to his material welfare. More explicitly, her object is not only to obtain an encyclopedic knowledge of the physical world, but also a philosophical and historical knowledge of it; that is, an understanding of the laws which govern it, and of the relation of those laws to each other. Science endeavors

to comprehend the system of the physical universe.

So that when the Christian recognizes the physical world as the work of God, and not only devoutly admires it but instinctively acknowledges that it is pervaded by divine wisdom, Physical Science stands prepared to unfold to him that wisdom as far as she has apprehended it. He knows that God made and rules it *somehow*. Science tells him *how*. And thus when the psalmist says: "O Lord, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches";* while with the aid of divine grace we may be able to rise to the same height of worship to which he rose, we shall, with the aid of physical science, understand something of the vast intellectual import of his words.

There are several familiar passages in the Scriptures in which the relation of Christ to the physical world is set forth. Without involving ourselves in the profound questions which centre about the Trinity, we may endeavor to form some simple conception of the meaning of these passages as far as it is of interest to an ordinarily thoughtful mind.

* Ps. civ. 24.

"The same was in the beginning with God. All things were made through him; and without him was not anything made that hath been made." — John i. 2, 3.*

"All things have been created through him and unto him." — Col. i. 16.

"And now, O Father, glorify thou me with thine own self with the glory which I had with thee before the world was." — John xvii. 5.

From such passages we may infer that the same Being who took upon Him our sins, and carried our sorrows, while in the flesh, had, while in the glory in which He had dwelt with the Father, been an agent in making the physical universe. Therefore as no soul enters Heaven without Him, so no crystal in the rock, flower in the field, or shell upon the shore is without Him whom we call our Lord and Master. He is the visible link between the spiritual and physical kingdoms of God. In Him centre all the mysteries both of godliness and of nature. The law of love and the law of nature proceed through Him; for the spiritual foundations of the Kingdom of Heaven were laid by Him in His earthly life

* Revised version, American rendering.

and sacrifice, and the physical and metaphysical foundations of the world were laid through Him in the counsels of eternity. The revelations of Faith and those of Science are thus revelations in the kingdoms of the one God and the one Word.

To illustrate this truth: Do we follow the scientist into all the minutiæ of his analysis, or back again as he builds up his magnificent synthesis, or do we accompany him as he patiently accumulates a vast number of concurrent facts, and then unfolds to us some great natural law, we are all the while but picking a cloth to pieces, thread by thread, or putting the same together again, thread by thread, or else reading the pattern according to which it was woven by a divine Workman. Do we turn from this to the study of the beautiful character of some saintly Christian ripe for Heaven, we are but examining another and a finer work from the same divine hand. Or, lastly, do we go to the inspired word, we there behold, in the face of Jesus Christ, the moral and personal character of the divine Workman himself, "full of grace and truth."

In the light of this truth nature and the

study of nature assume a most satisfactory aspect, as may be thus shown: In looking upon a mountain landscape we are first impressed with its beauty; and the more the eye has been trained to discern the beautiful, the greater will be our appreciation of the beauty of the scene. But if we have a knowledge of geology we shall, besides perceiving the beauty of form, color, and perspective, which at first engaged us, understand the structure, history, and origin of the mountains, and thus comprehend the scientific significance of the scene. And we shall not only consider the forces and laws by and under which the mountains were formed, but we shall be led to think of these in their effects upon the climate and vegetation of the surrounding country, and so in their relations to the wants of man. If, in addition to an eye trained to discern beauty, and a mind furnished with scientific knowledge, we possess Christian minds, we shall see the wisdom of our Heavenly Father displayed in the origin, history, structure, effect, and beauty of the mountains, and in reflecting upon it we shall find that our philosophical, æsthetical, and religious natures are all harmonized and satisfied. This aspect would

thus include all that a Newton, a Humboldt, an Agassiz or a Darwin, a Ritter and a Ruskin, have revealed to us of Nature, complemented and sanctified by that which Christ and Paul and John beheld in her. Thus while *Science* comprehends the mechanism of nature, *Faith* apprehends her Mechanist.

The practical effect of such an understanding of truth, both upon Christian faith and scientific pursuits, is apparent. Christian faith may well be *supplemented* by a knowledge of divine wisdom, and thus add the grace of intellectual humility to her graces of the heart, and discover new grounds for intelligent worship. And on the other hand, just as a knowledge of botany is incomplete without knowing the source of the heat and light which sustain vegetable life, so a knowledge of physical law needs to be *complemented* by a knowledge of the Giver of that law, although reasons much more momentous and personal than this are not lacking to draw the scientist into a moral and spiritual conformity to Him whose physical laws he so well understands.

Of the religious and intellectual satisfaction which the Christian mind experiences in

view of the divine goodness as shown in redeeming love, and the divine wisdom as manifested in the physical world, it may truly be said: "My heart is satisfied, for I have reached the issue of perfect benevolence; my reason is satisfied, for I have reached the issue of perfect wisdom." And this satisfaction has found outward expression also in lives which have united the moral beauty of Christian character to eminent attainments in physical science; although some of these Christian scientists may not have clearly discerned the bond of union between their faith and their science; and others have felt it their duty to forsake the attractive field of scientific research to minister more directly to the transcendent spiritual needs of their fellowmen.

When we consider the self-denying and patient researches, the unswerving loyalty to truth, the love of exactitude, and that beautiful intellectual humility begotten of much knowledge, which are so characteristic of the true man of science, we might think it but a step from these to the morality of the Sermon on the Mount, and of the 13th of First Corinthians. But Christian faith is the only solid

foundation of Christian morality. These intellectual virtues, however, are its fitting companions and its true analogues. There is indeed a natural harmony between the objective moral attitude of a healthful Christian life and the objective intellectual attitude of the genuine student of nature, or between study of, and obedience to the laws of our moral being and those of the physical world. Preachers and hymnists of all times have turned with fondness to the thought of this correlation between the moral and physical. Thus Robertson, in his sermon on the "Star in the East," exclaims: "Oh! be sure all the universe tells of Christ and leads to Christ. Rightly those ancient magians deemed, in believing that God was worshipped truly in that august temple. The stars preach the mind of Christ. Not as of old, when a mystic star guided their feet to Bethlehem; but now, to the mind of the astronomer, they tell of eternal order and harmony: they speak of changeless law, where no caprice reigns. You may calculate the star's return; and to the day, and hour, and minute it will be there. This is the fidelity of God. These mute masses obey the law impressed upon them by

their Creator's hand, unconsciously: and that law is the law of their own nature. To understand the laws of our nature, and consciously and reverently to obey them, that is the mind of Christ, the sublimest spirit of the Gospel."

Among the minds which have afforded living illustrations of the unison of an intellect masculine enough to master scientific truth, with a character genuine enough to entertain Christian faith, we may recall: Pascal, whose mathematical genius went hand in hand with his piety, and who but for the somewhat unwholesome type of the latter, and feeble health, would have accomplished far more for the world; Cuvier, who amid his great zoölogical and paleontological works, and while rendering numerous administrative services to his country, mainly in the cause of popular education, presided over a faculty of Protestant theology, was vice-president of a Bible society, caused the establishment of fifty new pastorates in France, and who left to history a blameless life; Isaac Newton, who not only caused copies of the Bible to be distributed to the needy, but studied that book himself; Chalmers, whose scientific apti-

tudes were as great as his fidelity in preaching the Gospel to the poor; Carl Ritter, the physical geographer, who in one of his treatises almost foreshadowed the missionary efforts which to-day are elevating the races of Africa; Buckland and Hugh Miller, whose popular works may speak for them; Faraday, who confessed that a spiritual knowledge of God is not to be obtained by scientific methods; the late Prof. James Clerk Maxwell, who "enriched the inheritance left by Newton, consolidated the work of Faraday, and impelled the mind of Cambridge to a fresh course of real investigation," and yet who is said to have been "a living contradiction to the fallacy that science and religion are antagonistic forces, — one of the most lovable of men, a sincere and unostentatious Christian, — of whom even his own friends could say, 'James has lived at the gate of heaven'"; and in our own country, the late Prof. Benjamin Silliman and President Edward Hitchcock, whose Christian character and influence many still remember; and also the recently departed Joseph Henry, who died, "resting his faith and hope upon Jesus Christ."

We may gather some lessons of practical

wisdom from the truth set forth. What should be the attitude of the Christian toward physical science, especially at the present time? Certainly not one of enmity, nor even one of indifference. We may deeply regret that one recently taken away, whom God endowed with rare capacities and opportunities to understand His works, may not have felt his need of a more living faith, and, while writing so much on the physical nature and relationships of man, gave his readers so little light on man's moral personality; or that another prominent naturalist of the day has not guarded language directed against a short-sighted interpretation of Scripture, from being understood as directed against revealed truth itself; or that a third, whose brilliant philosophical mind has scattered seeds of thought the world over, should yet fail to find room for a personal Deity in the universe. But we cannot refrain, if we would, from gladly welcoming the contributions of such minds to physical science, or from admiring their intellectual gifts and attainments. The revelations of science magnify God's wisdom. Let us, therefore, see to it that we be not found guilty of hindering the

cause of His benevolence by being too slow in recognizing that of His wisdom. Indeed, it is becoming in Christian philosophy quickly to appropriate and assimilate whatever scientific truth each revolution of thought precipitates from the troubled waters of controversy. Her readiness and skill in doing this will measure the amount of aid she renders to Christian faith in her conquest of men.

But on the other side, even if unable to convince Science of her need of God, we may doubtless insist that she also shall be true to herself. As we demand that religious profession shall be sustained by moral character, let us also insist upon scientific soundness in science, and then cordially receive her contributions. It is interesting to remember in this connection the public protest which some questionable data, hasty inferences, and unscientific language of Prof. Hæckel called forth from a German scientist speaking in behalf of a purer science,* and also the many indications of the general reaction among scientific men from untenable and extreme views. If Physical Science be but true to herself, she cannot fail of being true

*C. Semper, Der Häkelismus in der Zoologie. Hamburg, 1876.

to God, and so may unite with Christian Faith in the praise of Him in whom centre all knowledge and virtue.

Summarizing: The true basis of the harmony between Christian Faith and Physical Science has been shown to lie: —

First. In an apprehension of Religion as having mainly to do with the character of men.

Second. In an apprehension of the sphere of Science as purely intellectual.

Third. In understanding the reciprocal relations and benefits of these in the individual life.

Fourth. In a devout recognition of the divinity of Christ and his common relation to Man and to Nature.

SCIENTIFIC STUDIES:

THEIR PLACE AND USE IN EDUCATION.

TO CLASSICAL AND SCIENTIFIC TEACHERS.

"*Histories make men wise; poets witty; the mathematics subtill; naturall philosophy deepe; morall grave; logick and rhetorick able to contend.* — *Nay there is no stond or impediment in the wit, but may be wrought out by fit studies: like as diseases of the body, may have appropriate exercises.*" — BACON, *Of Study.*

IT would be as difficult as it is uncalled for, in these times of educational enlightenment, to advance new arguments to prove that scientific studies ought to occupy an important place in a systematic, liberal education, and that they both directly and indirectly subserve certain important ends. The word "scientific" here is used in its popular and more limited sense, with reference to the sciences of nature. But the attention of educators is often recalled to this truth by the recurring needs of society, and to students of nature it is always an interesting subject.

The place assigned to scientific studies in education not only affects the intellectual welfare of man, but has also to do indirectly

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This essay in its original form was read before the Poughkeepsie Society of Natural Science in 1878.

with his moral well-being, and thus with the whole end and nature of man himself. For the kind and amount of intellectual culture which men need depend primarily upon the object of all intellectual culture, and that depends upon the object of man's existence; but in order to understand the object of man's existence we must have a true conception of the nature of man, and of the world of being and of matter to which he is related. Going back, therefore, to this fundamental question, we may say briefly that he has a threefold nature, — physical, intellectual, and moral.

The physical world may be divided into matter, physical force, vegetable and animal life. At the head of the great system of animal life, with its various types and its multitudinous ramifications in time and space, stands man. The human body is the most perfect of animal organisms, whether we regard it as a piece of mechanical or biological mechanism, or consider it in its adaptation to man's intellectual and psychical necessities. The efficiency of this body may not only be maintained by obedience to the laws which govern it, but it may be increased, to a certain extent, by physical culture. The prolonged physical

and intellectual vigor of Mr. Gladstone is an example of the good results of careful living; and we need not go as far back as Grecian history to learn what gymnastics will do for physical development.

It is a truism that the intellect is capable of immense development. Perception, imagination, memory, and judgment may, by discipline and use, become highly efficient instruments for the acquisition and communication of knowledge. Intellectual culture, added to great native intellectual power, gave to the world Plato, Aristotle, Milton, Bacon, Newton, Goethe, Hegel, and Humboldt. The human intellect may explore the depths of mathematical truth, or may endeavor to grasp the outline and laws of the material cosmos, or turn its attention to the organic creation, and study the complex forces and laws of life. It may enter the realm of mind, and occupy itself with ideas and their infinite relations, or study the spirit of man as revealed in history, literature, and art, or it may ascend still higher to the sphere of moral truth, analyze the moral nature of man, study the moral government of God, and even reverently contemplate the divine character itself. Not only

is the mind capable of engaging in these exalted pursuits, but, in the field of action, it may play an important part in shaping the destinies of men and of nations, and may subdue the forces of nature to their service. Moreover, the mind is capable of rendering every shade and combination of thought into fitting and beautiful language for the purpose of intercourse or for the perpetuation of truth.

But the chief glory of man is his moral nature. This moral nature is susceptible of great culture, for man may become godlike in character. Thus we see the pharisaical young Hebrew, who consented to the murder of Stephen, transformed into the author of the chapter on Christian love, and affording the world in his own life one of the noblest examples of its matchless precepts. Thus also have multitudes of obscurer men and women buried their selfish natures, and attained to a true nobility of character.

Therefore each one of man's three natures is met by great possibilities; possibilities of retrograde or progressive development. We may debase our bodies, stunt our intellects, and grow morally ungodlike; or we may, by

physical culture, retain and increase the efficiency of our bodies, by intellectual culture develop and store our minds, and by a Christian life fit ourselves to enter upon a heavenly existence.

Mark Hopkins, in an address, beautifully sets forth the physical and moral nature of man and his relation to the physical world. He says: "Is there, then, no one end of nature as a whole that we can discover? I think there is; and that end I suppose to be the production of a man built up to the point where he takes possession of himself. That this is the end of nature as a whole, seems as plain to me as it is that the end of the plant is the production of fruit, and that the unity of the process of nature is found in relation to this, as that the unity of the process within the plant is to be found in nature's relation to that. What do you find? First, that this great mass of inorganic matter is combined and moved with a looking forward to a preparation for life But for the life which it sustains, the earth would have no value whatever. Then comes the lowest form of life. . . . Marvellous are the forms of vegetable life, but they have no value whatever except as they

bear relation to a life higher than themselves. Then comes another story, that of conscious, sensitive life. Man is to nature as a whole what nature is to the plant. . . . His moral nature is the highest. That requires love supreme to God and impartial love to man. Therefore as man is the crown of nature, so his moral perfection is the crown of man. Thus we have the perfect unity of man and nature."

We have been considering the nature of man; let us now look at the world to which he is so intimately related. Man is in the midst of a vast material and organic universe governed by forces acting in obedience to divine law. He is surrounded by personal intelligences and characters which constitute the intellectual and moral world. The presence of the element of a free will in a world of law results in great diversity as well as in great possibilities of good and evil. The aggregation of these physical, rational, and moral natures constitutes the complex fabric of human society, with all its numerous relations and obligations, and its social possibilities. Beyond all this, man is morally accountable to a Being of infinite excellencies and powers.

Such, then, in brief are the nature of man and the constitution of the world in which he exists.

Now the object of his existence evidently depends upon the nature of man himself, as well as upon the constitution of the world. Body, mind, and soul call for development; nature, man, and God claim his attention. It is also evident that any view of life which leaves out any of these subjective or objective elements is defective, and will produce defective results. For instance, let physical culture be pursued, and intellectual and moral culture neglected, we shall have only gymnasts, pedestrians, boating-men, etc. Let intellectual culture be pursued at the expense of physical and moral culture, the result will be mere intellectuality, with physical weakness on one side and moral insensibility on the other. Or let the moral element be cultivated and the physical and intellectual neglected, the result will be such as to defeat the very ends of morality. On the other hand, is nature made all? we have as a result materialism in its grosser or more intellectual forms; is man made all? we have a philanthropy which works blindly, understanding neither the

physical constitution of man nor the laws of his spiritual nature; is God made all? then we have as a consequence all the evils of dogmatism, asceticism, and monasticism. It is also evident that, while the neglect of any one of these elements will produce disastrous results, they cannot receive our attention in equal measure without mischief, but they must be pursued in the order of their relative importance.

First, that which makes for the moral nature.

Second, that which makes for the intellectual nature.

Third, that which makes for the physical nature.

And again objectively: first, God, — then man, — then nature. This rule will alone produce symmetrical and efficient men.

We now come to the question of intellectual culture in general. From what has been said we conclude that a right view of intellectual culture must assign it a place between moral and religious culture on the one hand, and physical culture on the other. Intellectual culture rightly understood presupposes then Christian character and Christian aims in life,

and should be accompanied with a due amount of physical culture.

Such being the relative position of intellectual culture, what are its ends and its means? As the end of life is to produce a symmetrical and efficient manhood, so the end of intellectual culture is to produce a symmetrically developed and efficient intellect. We took a hasty glance at the great avenues of intellectual endeavor; but a broad view of the constitution of the world will also enable us to determine the best means of intellectual culture.

Is nature all? Then we must devote ourselves exclusively to mathematics and the sciences of nature.

Is man all? Then we must turn to literature, art, and history, and to the sciences of mind and language.

Is God all? Then to moral philosophy and theology.

Evidently these must all be pursued, each in its measure. In order, therefore, to secure a truly liberal education every faculty of the mind ought to be developed, and every great department of knowledge ought to receive its share of attention.

The question as to the relative educational value of humanistic and scientific studies is wisely and well stated by Matthew Arnold in his work on "The Higher Schools and Universities in Germany."* He says: "The modern spirit tends to reach a new conception of the aim and office of instruction; when this conception is fully reached it will put an end to conflict, and will probably show both the humanists and the realists to have been right in their main ideas. . . . The prime, direct aim of instruction is to enable a man *to know himself and the world.* Such knowledge is the only sure basis for action, and this basis it is the true aim and office of instruction to supply. To know himself, a man must know the capabilities and performances of the human spirit, and the value of the humanities, of Alterthumswissenschaft, the science of antiquity, is, that it affords for this purpose an unsurpassed source of light and stimulus. Whoever seeks help for knowing himself from knowing the capabilities and performances of the human spirit, will nowhere find a more fruitful object of study than in the achievements of Greece in literature and the arts

*Second edition. London, 1874.

during the two centuries from the birth of Simonides to the death of Plato. And these two centuries are but the flowering point of a long period, during the whole of which the ancient world offers, to the student of the capabilities and performances of the human spirit, lessons of capital importance. This the humanists have perceived, and the truth of this perception of theirs is the stronghold of their position. It is a vital and formative knowledge to know the most powerful manifestations of the human spirit's activity, for the knowledge of them greatly feeds and quickens our own activity; and they are very imperfectly known without knowing ancient Greece and Rome. But it is also a vital and formative knowledge to know the world, the laws which govern nature, and man as a part of nature. This the realists have perceived, and the truth of this perception, too, is inexpugnable. Every man is born with aptitudes which give him access to vital and formative knowledge by one of these roads; either by the road of studying man and his works, or by studying nature and her works. The business of instruction is to seize and develop these aptitudes. The great and complete

spirits, which have all the aptitudes for both roads of knowledge, are rare. *But much might be done on both roads by the same mind, if instruction clearly grasped the idea of the entire system of aptitudes for which it has to provide; of their correlation and of their equipollency, so to speak, as all leading, if rightly employed, to vital knowledge; and if then having grasped this idea, it provided for them.* The Greek spirit, after its splendid hour of creative activity was gone, gave our race another precious lesson by exhibiting, in the career of men like Aristotle and the great students of Alexandria, this idea of *the correlation and equal dignity of the most different departments of human knowledge, and by showing the possibility of uniting them in a single mind's education.* . . . As our public instruction gets a clearer view of its own functions, of the relations of the human spirit to knowledge, and of the entire circle of knowledge, it will certainly more *learn to awaken in its pupils an interest in that entire circle, and less allow them to remain total strangers to any part of it.*"

Edward L. Pierce, in his Memoir of Charles Sumner, relates an interesting incident which is not inappropriate in this connection. He

says: "He excelled in translations, and entered into the spirit of the authors so sympathetically that their best passages became fixed in his memory, and were ever after available for use. . . . In history and belles-lettres, he was also among the foremost. . . . But while succeeding in these branches, he entirely failed in mathematics. He had no faculty for the science, and he became disheartened and disgusted with the study." Further on, in relating the events of Sumner's first post-graduate year, the author says: "At this time he set himself to a study always disagreeable to those who, like him, have for it no natural aptitude. Mathematics, to which, as already stated, he gave very little attention in college, he now felt to be a necessary part of a complete education, and determined to overcome his deficiencies in the neglected science He at once entered with zeal on the study of geometry, and found it less difficult than before."

On the other hand, the importance of not pursuing the study of the sciences to the neglect of that of the humanities is well shown by the following extract from a letter from a member of the faculty of one of our older

Eastern "Universities." The writer says: "We graduate two sets of boys (or 'men') every year, and one set has been trained chiefly by the study of science, the other chiefly by that of literature. There is no disparity in the natural capacity of the two sets, and certainly none in the capacity and fidelity of their teachers. But we find that the graduates in arts have been coming steadily up to the level of their teachers as cultivated, thoughtful men, capable of taking large views of life. On the other hand, we feel that a great gulf lies between the scientific graduates and their professors even of purely scientific branches. All of these latter are men of classical culture, and there is not one of them who will allow that sort of education to be disparaged in his presence."

The importance of this is still more strongly shown by the recent opinion of the Philosophical Faculty of the University of Berlin, to the effect that "the ideality of the scientific sense, interest in learning not dependent upon or limited by practical aims, but ministering to the liberal education of the mind as such, the many-sided and widely extended exercise of the thinking power, and an ac-

quaintance with the classical bases of our science and civilization, can be satisfactorily cultivated only in our institutions of classical learning."*

But humanistic and scientific studies, alone, do not constitute the whole circle of knowledge. They have to do with nature and the physical and intellectual side of man. They would have satisfied an ancient Roman or Greek scholar, but they cannot meet the demands of a Christian civilization. We must complement them with the study of Christian ethics and Biblical theology.† These extend our knowledge to the moral and spiritual side of man's constitution, and to the divine character and government. They also form a most

*See Dr. August Wilhelm Hofmann, The Question of a Division of the Philosophical Faculty. 2d edition, with an appendix. Boston, 1883.

† Mr. Matthew Arnold, in his lecture on the relation of literature and science in education, recently delivered in this country, claims that scientific studies, alone, fail to satisfy "the sense for conduct," and "the sense for beauty," because the facts and truths with which the sciences have to do are not easily brought into relation with man's ethical and æsthetical nature. But would it not be fair to supplement this statement by asking whether a living apprehension of Christian truth, that is, that virile and personal and tender experience of it which grows out of a hearty recognition of its supernatural origin, is not, after all, the source of the fullest satisfaction of "the sense for conduct," both in the man of science and the man of letters, and also whether he who has such an apprehension of Christian truth will not more readily relate the facts and truths of nature to his "sense for conduct," and even to his "sense for beauty"?

important means of cultivating those faculties which deal with moral problems. And it may well be asked, whether the general lack of a philosophical understanding of Christian truth does not as much lie at the basis of the scepticism of to-day as does a bad state of the heart. For these reasons, religious and moral philosophy ought to form a part of every liberal education.

Thus the circle of knowledge becomes complete. It comprises nature, man, and God, which correspond to the three great means of intellectual culture, — *scientific*, *humanistic*, and *theological* studies. The sphere of scientific studies may then be thus defined: *It is one of the three great means of intellectual culture which together go toward the upbuilding of a symmetrical and efficient intellect.* And this intellectual culture, together with moral and physical culture, go toward the upbuilding of a symmetrical and efficient manhood. Such is the place of scientific studies in a complete education.

Now let us consider the use of scientific studies, that is, their direct and indirect effect, as one of the contributors to this grand result.

1. *They cultivate the spirit of investigation.* We need but examine for a moment the spirit which animates the sciences of nature in order to perceive the truth of this. We find that they flourish best in an atmosphere of intellectual freedom. They must be free from ecclesiastical dogma, while they strive to expose superstition and bring the mysterious within the domain of the known. They subject individual opinion to the ordeal of public criticism by offering the prize of a scientific reputation to the discoverer of truth. Their mission is simply to find and state the truth; and to this they know of no royal road but that which leads through original research, accurate observation, careful induction, and lucid statement.

2. *They acquaint us with natural law and with nature.* The sciences of nature can never content themselves with the mere amassing of observations, excepting as these constitute the foundation of inductive science. Not the facts, but their significance constitutes science. That significance is always and everywhere law; and that law, as we have seen, is as divine in the sphere of nature as the Decalogue is in the sphere of

morals.* The student of nature thus gets imbued with the truth that he lives in a world of law, moral as well as physical. But he also acquires a knowledge of the physical constitution of man and of the physical universe, which wonderfully enlarges and satisfies his mind.

3. *They cultivate philosophical insight.* This may be illustrated by taking any common roadside plant. The unphilosophical observer notices it simply as a familiar object; perhaps he knows its name and admires its beauty; but to the botanist it reveals a world of thought. First, he observes its systematic position in the vegetable kingdom as an individual of a certain species, genus, family, order, etc. Second, considering its roots, stems, leaves, and flowers, their various parts, forms, and positions, he discerns their mathematical and morphological relations, and his thought is thus led back to "the archetype to which all the modifications of the root, stem, and leaf can be referred," that is, "to the original idea which presided at their construction." Third, looking at it physiologically and microscopically.

* See first essay.

he considers the universal biological, chemical, and physical laws under the government of which the plant grows and multiplies; and thus it is brought into connection, not only with all life, animal as well as vegetable, but also with astronomical law. Fourth, he considers it geographically, and is reminded of the causes which limit its vertical and horizontal distribution, such as the climate, nature of the soil, position, and the action of animals or of men upon it. Lastly, he considers the changes in its size, form, and color which may be brought about by its environment. Thus this one common object acquires a philosophical significance almost universal. Again: the intelligent traveller is impressed with the grandeur of the Norwegian fjords; he observes their number, their extent, and their intricate and precipitous shores. This is to him an interesting series of facts, but no more. Let a physical geographer observe the same phenomena, and they assume at once a much deeper and wider significance. In his eyes the fjords are merely prolonged valleys, once the beds of glaciers, but now overflowed by the sea. He attributes the complicated, arborescent

coast-line to sedimentation, metamorphism, upheaval, and depression, followed by erosion and glaciation, that is, by the chemical and physical action of water and ice upon the peculiar structure and mineralogical composition of the rocks; and he looks for the cause of these changes of surface and climate in the earth's past and present cosmical relations. But he goes still further, and considers the effect of the depth of the fjord upon the character of its marine fauna, and the effect of the general features of the country upon its inhabitants, conditioning the character of their nourishment, employment, and, to a certain extent, influencing their mental and moral habits, and even coloring their national history. The fjords are thus no longer an isolated phenomenon, but a link in an endless chain of cause and effect, reaching through all time, space, and matter, and even extending to the human mind itself. A person habituated to such courses of thought in regard to natural objects soon applies them to other objects, to questions in ethics, art, and history, and thus acquires a philosophical cast of mind; and the deep significance of this will be still more manifest

if, as some have claimed, the physical world is governed by processes which are but analogous to those which prevail in the social, intellectual, and moral life of man. This philosophical insight into nature will furnish the student of man with the key to many problems of a higher order. As Bacon tersely puts it, "naturall philosophy makes men deepe."

4. *Scientific studies produce intellectual humility.* Knowledge of the vast and intricate machinery of nature calls our attention to our own ignorance, and we become intellectually humble just in proportion to the amount of our knowledge. Scientific men, alas! are not always humble at heart; but it would be difficult to find a scientific man of much experience, who is not childlike when he comes into the presence of Nature. Indeed, intellectual humility is an imperative condition of progress in natural science. This is so true that the degree of any one's attainment in science may generally be measured by his acquisitions in this scholarly virtue.

5. *They teach method.* This they do by means of their analyses, syntheses, and classifications. A recent German monograph will

serve as an example. The author, having obtained from public and private collections many specimens of fossil sponges, publishes the results of his investigations. After giving the literature, and showing the present state of science on the subject, he proceeds to describe the new genera and species which he discovered. For this purpose he had a number of microscopic sections made, which, when magnified, revealed not only the minute fibres and spicules, but also their varied and complicated structure. Based upon a careful study of these, and of the complete specimens, he gives a precise description of each species and genus, its name, zoölogical, geological, and geographical position. Accompanying each description is an engraving of the complete sponge and of the microscopic section; and, for purposes of comparison, engravings of the extant sponges of the same order are added. Having given a number of these minute analyses, he proceeds synthetically to make out a table of the genera and species, showing their succession in time, their morphological and their presumable genetic relations. Finally, he adds an analytical key in order to enable the student to

ascertain the name and position of any specimen. Now no one can perform work of this kind, even on a small scale, without acquiring methodical habits of mind which will be invaluable in the study of almost any subject or the pursuit of any object. And what is true of the methods of the palæozoölogist is equally true of those of the botanist, chemist, or physicist.

6. *They cultivate a scrupulous exactitude in observation and comparison, a habit of carefully weighing probabilities, and a reserve of judgment.* Inasmuch as the advancement of inductive science depends upon the accurate observation and comparison of phenomena, and upon the weighing of probabilities with a view of making sound inductions, these habits of mind are necessarily cultivated, and some of them may even extend their influence so far as to color the moral habits.

7. *They chasten and strengthen the imagination.* While scientific studies require for their successful pursuit the aid of imagination, they also exert a wholesome influence upon that faculty, and constantly recall it from its flights into the ideal back to the real. Sir David Brewster says of the imagination:

"This faculty is of the greatest value in physical inquiries. If we use it as a guide and confide in its indications it will infallibly deceive us, but if we employ it as an auxiliary it will afford us the most invaluable aid. Its operation is like that of the light troops which are sent out to ascertain the strength and position of the enemy. When the struggle commences, their services terminate; and it is by the solid phalanx of the judgment that the battle must be fought and won." De la Chapelle, a French mathematician, and a member of the Royal Society, in a work on geometry, published in 1765,* speaking of the influence of mathematical studies on the imagination, says: "No man is born without a certain amount of imagination. Art and study enlarge our faculties, but do not give them to us.

"Among the different kinds of imaginations which Nature has distributed among men, and which interest us, there are three: the strong, the beautiful, and the ordinary. In looking at nature we only perceive its exterior, while

* De La Chapelle, Institutions de géométrie enrichies de notes critiques et philosophiques sur la nature et les développemens de l'esprit humain avec un discours sur l'étude des mathématiques. 4me édit. Paris, 1765.

a strong imagination penetrates into its interior. It is present, if we may use the expression, at the working of the machinery, of which the weak imagination only sees the effects. A beautiful imagination can adorn an object with the divers beauties which Nature has scattered here and there on the infinite multitude of her productions. Struck by the least discord, she substitutes everything which tends to produce harmony, and removes or suppresses all that can impair it. As to the ordinary imaginations, they are lively without being warm. Inconstant, they emit but sparks whose light goes out at once. Such imaginations yield projects rather than products, and as they are incapable of production, answer the purposes of imitation. What happens when education presents different objects to these different orders of minds? Each imagination seizes that which corresponds most nearly to its nature, after having tried a little of everything which is not thus adapted to it. The ordinary imagination will alone be subjugated, and it will not be a great loss. Mathematical studies (and all this holds largely true of scientific studies) would certainly render

good service to literature if they substituted a careful and exact judgment for a weak and sterile imagination. We fail, therefore, to see any danger in the pursuit of mathematical studies. They are the element of the strong imaginations and the grave of the weak ones. The beautiful ones can dispense with them." This last statement of our author needs modification, for beautiful imaginations require the very culture which will tend to strengthen and deepen them; and it has been found that even those who devote themselves to the fine arts are benfited by the study of a certain amount of natural science.

There is a difference of opinion as to whether the ancient Greek sculptors studied anatomy. It is, however, certain that their works show a remarkable understanding of nature. An art critic once said that if any one was to break off a toe from one of the Elgin marbles he would prove "the great consequences of vitality, as it acts externally, to exist in that toe." Salvage, in a work on "The Anatomy of the Fighting Gladiator," for the use of sculptors and painters,* says:

* Jean Galbert Salvage, Anatomie du Gladiateur combattant applicable aux Beaux Arts. Paris, 1812.

"It is only when the scholar has by several degrees attained to drawing from the living model, and copies it well, that, by virtue of his success, he encounters obstacles till then unknown. The articulations, the muscles which cause them to act, the forms which they present on certain occasions, and their depression at others, bar his progress. Then he needs to study anatomy both in books and in nature. As soon as he does this his eyes are opened, his doubts vanish, his errors are corrected, and his difficulties are almost overcome. In the delight which he experiences from his new acquirements he goes back to the antique; there he admires the beauty of nature supported by a fine bony framework covered with great muscles. In studying the Hercules Farnese, the Laocoön, the Gladiator, the Apollo, and the Venus de Medici, he notices, to his surprise, that there has been a perfect rivalry between art and science in the production of these masterpieces." In another place the same author adds: "The most gifted minds, who, while trusting to the caprices of the imagination, disdain to consult nature, of which the antique is but a perfect imitation, and who refuse to study

the beautiful forms which anatomy shows in all their relations, will soon be led astray. In vain will their most brilliant compositions shine with rich accessories; they will be defective as long as they are without that which constitutes sentiment and truth in the imitative arts. But a noble genius, enlightened by the torch of science and made fertile by meditation, will never depart from the unvarying rules of the beautiful."

Scientific and humanistic views of nature are well illustrated by a German architect, in an address delivered before the Industrial Art Union of Munich, on "The Influence of Art and Industrial Art upon the Education of the Imagination." * He says: "I give to my understanding and to my imagination the same object of thought in order that each may attach to it the train of thought which it suggests to it. For example, let us take a spring. In considering it the understanding says: This spring is the outlet of a subterranean reservoir. Its composition is conditioned by the chemical composition of the

* J. Von Schmædel, architect, Über den Einflusz der Kunst und des Kunsthandwerkes auf die Erziehung der Phantasie. Zeitschrift des Kunst-Gewerbe-Vereins. Nos. 3-6. Münich, 1577.

earth with which the water has come in contact. Its volume depends upon certain mechanical and physical conditions, etc. In short, the course of thought which the understanding attaches to this object concerns merely those things which are absolutely comprehensible, and which stand in immediate and logically demonstrable connection with the object itself. Now let us hand over the same object to the imagination, and it would suggest some such poem as that by Schwind, in which the spring is brought into connection with human joy and sorrow. How he leads us on in it to holy joy and delight and touches our heart strings." Our minds need both kinds of culture, if we would attain to intellectual symmetry. We must know *truth of nature* as well as *truth of man*, if we would maintain the equilibrium between the understanding and the imagination. But when we weigh these two methods of viewing nature, while we shall always enjoy the artistic and poetic method, we shall in the end prefer the method of the naturalist, certainly as a foundation for thought, and say with Wordsworth, "To the solid ground of Nature trusts the mind which builds for aye." Not

that we would let the din of Nature's machinery silence the voice of Poetry within us; but rather let a thorough knowledge of nature minister to a deeper poetic sentiment. Every geologist can testify that a knowledge of geology adds immensely to the merely æsthetic enjoyment of nature. When we have studied a group of mountains or any tract of country, physiographically, geologically, and palæontologically, we make it in a peculiar sense our intellectual possession, and enter into a depth of communion with nature and with the mind revealed in nature which is as the nut to the shell, when compared to the satisfaction which we derive from subjecting the same objects to our mere imaginations, however highly cultivated. The value of some of Leonardo da Vinci's writings on art is imperishable because they combine real knowledge of nature with artistic perception. The same spirit pervades some of the works of Tennyson, of whom an American chemist justly says: "The poet laureate of England has drawn a deeper inspiration from nature interpreted by science than any of his predecessors of the classical school." Chalmers describes the effect of scientific study upon

the imagination with his usual weight and richness of language: "It is thus that at the commencement of the observational process there is the abjuration of beauty. But it soon reappears in another form, and brightens as we advance, and at length there arises on solid foundation a fairer and goodlier system than ever floated in airy romance before the eye of genius. Nor is it difficult to perceive the reason of this. What we discover by observation is the product of divine imagination bodied forth by creative power into a stable and enduring reality. What we devise by our own ingenuity is but the product of human imagination. The one is the solid archetype of those conceptions which are in the mind of God; the other is the shadowy representation of those conceptions which are in the mind of man. It is just as with the laborer, who, by excavating the rubbish which hides and besets some noble architecture, does more for the gratification of our taste than if by his unpractised hand he should attempt to regale us with plans and sketches of his own. And so the drudgery of experimental science, in exchange for that beauty whose fascination it withstood at the out-

set of its career, has evolved a surpassing beauty among the realities of truth and nature." *

8. *Scientific studies cultivate an accurate use of language.* The accuracy of statement and the nicety of definition, which so largely constitute the value of scientific papers, are most excellent correctives of the rhetorical habits which humanistic studies are very apt to form, unless far pursued. The general aim of Science is to cultivate what we may very appropriately term *the eloquence of truth as contained in facts;* and what is more significant than a fact, be it in nature, history, or religious life? She abhors the language of enthusiasm, and seeks to embody solid matter in few words; so that we are led to a literary result akin to that to which a thorough study of the classics would also lead us, which is simplicity of style.

Finally, *this spirit of investigation, knowledge of natural law and of nature, this philosophical insight, intellectual humility, method, exactitude in observation and comparison, this habit of carefully weighing probabilities, this*

* Natural Theology: "On Man's Partial and Limited Knowledge of Divine Things."

reserve of judgment, chastened and strengthened imagination, and this accurate use of language are valuable in the first place and chiefly, on account of their intrinsic excellence; and, secondly, because they render their possessor a source of power and good influence. Our country needs such minds in all the public walks of life: in the pulpit, in medicine, in the editorial chair, at the bar, in the legislative assembly, in commerce, agriculture, literature, education, and of course in all those professions and occupations which require technological preparation. Less dogmatism and more disposition to search and understand the real nature of things human and divine would become some of our theologians. A more chastened rhetoric would add force to some of our popular sermons. A more disinterested love of medical science, more thoroughness in diagnosis and in treatment, are needed in the medical profession. A deeper reverence for truth, and more concise language would render our popular books and newspapers more instructive. Our legislators would be benefited by a deeper knowledge of the laws which govern finance and commerce; the judgment of our merchants

would be more sound; our agriculturists would be more scientific, and none the less practical; our educators would deal more with vital knowledge, and better understand the minds and bodies committed to their care; our railroads would be managed with greater security to human life; our manufacturers would not waste so much capital in needless experiment. In short, souls, minds, bodies, and property would be better cared for.

To recapitulate: we have seen that physical, intellectual, and moral culture constitute education in the true sense; we have seen that in a complete and symmetrical intellectual education the sciences ought to occupy a prominent place with the humanities and with Christian ethics and religious philosophy. As to their use, we have seen that, by the discipline and information which they impart, the sciences are not only calculated to produce a very high order of intellectual culture, but also to exert a beneficent influence upon every sphere of thought and action; and it would not be easy to enumerate the vast consequences of special scientific study to civilization, both in the advancement of science

and in the increase of wealth and physical and social well-being.

There may be a question as to the relative position to be assigned to the sciences in a college course. Undoubtedly classical studies afford an excellent and invaluable literary preparation for the successful pursuit of more advanced scientific studies; but the legitimate results of such a broad education as that delineated will not be reached in the ordinary curriculum, unless full justice is done to the sciences by just as thoroughly preparing the student, through an early acquaintance with elementary science, for original scientific investigations as he is now prepared, by early drill in the elements of classical learning, for the more philosophical study of ancient literature. This will not be accomplished by deferring the study of nature to the end of a college course, when for lack of time it must be pursued in a very superficial way. The study of nature ought to be begun in childhood; and this can be very easily done, because it appeals to the understanding through the eye. On this account it is much more appropriate for even some older children than the study of grammar which involves

difficult metaphysical conceptions at the outset. We must apply not literary but scientific methods to the study of the sciences in order to bring the student's mind in contact with Nature herself. The phenomena must be placed before the student first, the terminology and the laws afterwards. While he thus studies nature, he himself becomes scientific, which is a more valuable educational result than the mere acquisition of knowledge. Instead of making scientific studies, as is the case in some of our institutions, merely optional, so that students with literary aptitudes escape the scientific culture which they need, these as well as classical studies ought to be made obligatory upon all. Finally, the teacher must himself have studied nature, or he cannot teach others about nature. Education may thus even in its elementary stages be pursued upon the most advanced principles. But it will not be difficult, having once accepted a sound philosophy of education, to find ways of putting it into practice.

When these principles are put into practice, and by that is to be understood all that has been claimed for physical, moral,

scientific, humanistic, and theological culture, we shall be able to look forward to the educated men and women of the future with great expectations. For they will not only have *every side* of their nature developed to the highest point of efficiency and symmetry, not only will they be conversant with the whole circle of knowledge, but they will also be able to meet the actual needs of society; because their education will have been based upon the whole nature of man, and upon that of the world in which he lives. And such an education will furnish them also with powerful incentives to go and do the work which the world has for them to do.

ON THE

INTERPRETATION OF THE FIRST CHAPTER

OF THE

BOOK OF GENESIS.

TO BIBLICAL AND GEOLOGICAL STUDENTS.

"*The sacred Scriptures are not a course of physics, they do not employ the language of science, still less that of any particular system : . . . but they do teach, and that on every page and by every means, that the heavens declare the glory of their Author.*" — VICTOR COUSIN.

"*To conclude, therefore, let no man out of a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavor an endless progress or proficience in both.*" — BACON, *Advancement of Learning.*

Genesis i. 1–31 ; ii. 1–3; *Exodus* xx. 1–11.

THE Book of Genesis is now generally supposed to be the work of at least two if not three separate authors, neither of whom probably was the compiler of the whole book. Exactly what part of the work, if any, is to be ascribed to Moses, and at what time the original documents were framed or the compilation was made, are still matters of controversy among eminent Biblical scholars.*

* The possibility of a double authorship was first pointed out by a French physician, J. Astruc, in a work entitled Conjectures sur les mémoires originaux d'ont il est permis de croire que Moïse s'est servi pour composer le livre de la Genèse avec des remarques qui appuient ou éclaircissent ces conjectures. Bruxelles, 1753. See on the question of authorship and compilation, and for the literature: Frz. Delitzsch, Commentar über die Genesis. 4th edit. Leipzig, 1872. C. Frdr. Keil. Genesis u. Exodus. 3d edit. Leipzig, 1878. August Dillmann, Die Genesis. 4th edit. Leipzig, 1882.

Some of the reasons for these suppositions and uncertainties are, that different styles of expression, of names for the Divinity, and different accounts of the same events, characterize portions of the book; that a tradition of the flood, in some respects similar to the Bible narrative, was current in Babylonia before the time of Moses, probably as early as 2000 B. C.; and, finally, that a careful comparison of the book with other parts of the Old Testament raises a question as to the time of its compilation. Was the cosmogony at the beginning of Genesis brought from Chaldea in the form of a sacred tradition by Abraham when he migrated from Ur? May we infer from the high state of civilization and literature in the midst of which Moses was educated that he had something to do with the book? What exactly were the relations of the original narratives of Genesis to the Babylonian and Iranian traditions? All these are highly interesting questions, which, however, it seems scarcely prudent for any one at present to answer in a dogmatic spirit. But however much of mystery may surround the authorship and compilation of the book, it is evident that some of its traditional sources

date back to the time of the patriarchs, and others even to a far more remote antiquity.* The vast moral and spiritual superiority as well as the marked simplicity of this cosmogony, compared with those of other nations of high antiquity, cannot be questioned.†

Moses lived, according to various chronologies, between 1,600 and 1,300 years before Christ, or between 3,200 and 3,500 years ago. Some chronologies would place the creation of man 6,000 or 7,000 years ago; but Bunsen's estimate places it about 22,000 years ago,‡ and geological history carries us back to untold ages before the appearance of man. The opening sentences of the Book of Genesis are

* See on these subjects, Eberh. Schrader, Die Keilinschriften und das Alte Testament. Mit einem Beitrage von Dr. Paul Haupt. 2d edit. Giessen, 1883. A. Dillmann, Über die Herkunft der urgeschichtlichen Sagen der Hebräer. In the Sitzungsberichte der Kgl. preuszischen Akademie der Wissenschaften zu Berlin, No. 18–22. 1882. Translation in the Bibliotheca Sacra for July, 1883. François Lenormant, Les Origines de L'histoire d'après la Bible. Paris, 1882. Translation N. Y. 1882. Paul Haupt, Der Keilinschriftliche Sintfluthbericht, eine Episode des Babylonischen Nimrodepos. Leipzig, 1880. Abstracts of the last two works in the Bib. Sacra, July, 1883.

† See Dillmann, Genesis, pp. 4–10, 14.

‡ Dr. H. Brugsch-Bey, in his History of Egypt under the Pharaohs (transl. London, 1881, 2d edit.), gives cautiously the year 4400 B. C. as the date of the First Dynasty or the commencement of the historic period in Egypt. This would take us back 6,280 years to a period which must have been preceded by many centuries of primitive social development. On the other hand, Rev. Geo. Rawlinson, in his Origin of Nations (1877), places the probable date of the rise of monarchy in Egypt as late as 2450 B. C.

not only among the earliest Biblical writings, but they, together with the twentieth chapter of Exodus, which contains the language of Moses himself, convey to us nearly all that Biblical authors have to say of a definite character on the origin of the earth and its organisms. These writings come to us fragrant with highly ancient and sacred associations, and lead our thoughts back through all the primitive history of man and of nature to the infinite Being Himself.

In order to apprehend the significance of such writings we must not only place ourselves in the intellectual and moral attitude called for by the vast and exalted nature of the subject of which they treat, but we must also find a key to the language of the records. These will be found indicated, the writer believes, in the following *four principles of interpretation.*

Firstly. Written language must be understood as meaning primarily what it meant to the persons for whom it was first written. The actual significance of the words at the time must take precedence of their possible philosophical significance. In order to ascertain this we should not only possess an accu-

rate knowledge of the grammar and genius of the original, but we should also make ourselves familiar with the modes of thought current in the country where, among the people with whom, and at the time when the writings originated. We should transport ourselves in imagination to those distant times and lands, and live the life of those archaic peoples. The absurdity of applying Anglo-Saxon methods of thought to the interpretation of Oriental ones is apparent, nor need we go any farther than our houses of Christian worship to listen sometimes to an equally incongruous mixture of Orientalisms and Americanisms. A thorough knowledge of the original is the hard-won privilege of few; but an acquaintance with Eastern habits of thought, which in this case is of equal if not greater importance, is more readily obtained. We should also ascertain to what class of people the words were addressed, whether to the learned or the common people, and thus determine whether the language is to be understood in a scientific or abstruse sense, or in the sense of ordinary narration or intercourse. Coleridge answers the latter question thus: "On moral subjects the Scriptures

speak in the language of the affections which they excite in us; on sensible subjects, neither metaphysically, as they are known by superior intelligences, nor theoretically, as they would be seen by us were we placed in the sun; but as they are represented by our human senses in our present relative position."*

Tayler Lewis makes this matter very clear: "Words present images, or conceptions. Images or conceptions (or in other words phenomena) *represent* the ultimate facts that stand away behind them. Thus all language is mainly if not wholly phenomenal. But here again arise three distinctions. There is *the simply phenomenal*, *the scientific*, and *the poetical*. . . . The first employs only those appearances which present themselves directly and primarily, or as we might say, spontaneously, to the sense, — that are alike in all men, and thus directly represent for all men the ineffable fact standing behind them at however remote a distance. . . . The object of the first is simply to give the more vivid thought of the ineffable fact as a fact with-

* Aids to Reflection.

out reference to its philosophy. The object of the second is to explain the relation of phenomena to each other, and if possible . . . to trace their connection all the way up to the great ultimate truth or agency they represent. The design of the third is not only to give a clear thought, like the first, but to connect with it some strong emotion."* The term "poetic" may also be applied to language which, while not calculated to excite the feelings, yet for artistic purposes employs images which are not necessary for the mere representation of phenomena. In a word, we should have *just and clear ideas as to the language of Scripture.*

Secondly. Granting, therefore, that the language of Scripture in regard to nature is both Oriental and phenomenal, it must not be overlooked that phenomenal language is only phenomenally correct. The scientific aspect of nature is alone physically true. Thus when we say, 'The sun rises,' we describe a phenomenon in popular or phenomenal language; but if we wish to describe the same phenomenon in scientific language, we say, 'The earth in revolving on its axis has

* The Six Days of Creation, Schenectady, 1855, pp. 41, 42.

brought us within sight of the sun.' The last statement implies and conveys some knowledge of the constitution of nature, but the first does not. Therefore, as the Bible cosmogony deals with nature, we must, in order to an intelligent apprehension of the subject, bring to its study *a scientific acquaintance with nature.*

Thirdly. We must also be in sympathy with the general object of Scripture, which is not primarily to reveal to us the laws of nature, and build up the intellectual man, but to reveal the divine character, and restore to man the divine image. Indirectly our minds will of course be enlarged and awakened as, indeed, our whole nature becomes purified and stimulated by a personal knowledge of God; and Bible truth is necessarily interwoven with much of history, geography, literature, and nature, for it is humane as well as divine; but the aim of the book is a religious and moral one, for religion and morals are at the centre of human nature. We must, therefore, bring to the study of this portion of Scripture *a God-loving mind.*

Fourthly. But religious sentiment without religious principle and thought is as unable

to stand the strain from within and without as a house without a framework. We must have *some doctrinal and philosophical basis* which shall be broad enough and strong enough to support the whole structure of religious and scientific truth as well as anchor our own faith and reason. Such a foundation has been exhibited.* *In nature we see some of the institutions of the divine mind; in Revelation we learn to know the moral laws which proceed from the divine character.*

Accepting these principles of interpretation, there seems less difficulty in arriving at a satisfactory understanding of the first chapter of Genesis.

The earth and life are represented to us as having been created in "*six*" days; and in the twentieth chapter of Exodus the same statement is repeated, and serves as a basis for the Sabbatic Commandment. Exodus xx. contains the oldest form in which the Decalogue has been transmitted, and is of Mosaic authorship.† The reason there assigned for the observance of the

*See first essay.

†See Franz Delitzsch, Der Dekalog in Exodus und Deuteronomium. Zeitschrift für Kirchliche Wissenschaft und Kirchliches Leben. Heft VI. Leipzig, 1882.

Sabbath, because of its difference from that given in Deut. v., has been thought by some modern critics to be a later interpolation; but Delitzsch shows that there is no ground for such a supposition, and that there is no conflict between the two passages. In Exod. xx. 11 the divine example is given as a reason for the observance, whereas in Deut. v. 14, 15, the humane treatment of servants, as flowing out of that observance, is inculcated and followed by a reference to Israel's recollection of Egyptian servitude. We thus find Moses teaching and believing the substance of the first cosmogony, and incorporating it in the Decalogue. Its claim to inspiration would thus seem to rest on as strong a foundation as that of the Commandments themselves.

We find that numbers were used among Eastern nations in two ways: first, in a *determinative* sense, as in our ordinary use of numbers, to indicate order and quantity; second, in a *representative* or *indeterminate* sense. Thus we use the numbers 12, 20, 100, or 1,000 when we wish to denote not an exact number, but to convey the idea of a few, many, or a multitude; and the Hindoos at

the present day use in a similar way the figures 2 – 20 and 5 – 50 to denote a lesser or greater indefinite number.* Numbers may not only be thus employed to represent an *indeterminate quantity,* but they may be made to convey also the idea of *quality,* and so acquire a *symbolical* significance. The Eastern aversion to exact numerical statement, though arising largely from superstition, is yet indicative of a type of mind very different from ours. Burckhardt says : " For the same reason that a Bedouin never counts the tents of his tribe, nor the exact number of his sheep, nor a military chief the exact number of his men, nor a governor the number of inhabitants of his town, a merchant never attempts to ascertain the exact amount of his property ; an approximation only is all that he desires. This arises from a belief that counting is an ostentatious display of wealth, which Heaven will punish by a speedy diminution."† The truth to which this superstition points is indicated in David's counting his men of war.‡

* Stated by Rev. C. W. Park, lately a missionary in India.

† J. L. Burckhardt, Travels in Arabia, London, 1829, Vol. I. pp. 74, 75.

‡ II Sam. xxiv.

The most casual reader of the Bible is familiar with the frequent occurrence of the numbers 7, 10, and 12. That these were used in the Book of Revelation in a symbolical sense is well understood; but that numbers at the other end of the Bible may have had a similar significance has not been generally admitted in recent times.

The allegoric and Platonistic vagaries of Philo Judæus * (born at Alexandria, 20–50 B. C.) have been justly discarded; but it is possible that as his doctrine of the Logos contains the intellectual semblance of a fundamental New Testament truth, so may perhaps his understanding of the Bible cosmogony throw light upon it: "And he (Moses) says that the world was made in *six* days, not because the Creator stood in need of a length of time, . . . but because the things created required arrangement; and number is akin to arrangement; and, of all numbers, six is, by the laws of nature, the most productive: for of all the numbers from the unit upwards, it is the first perfect one, being made equal to its parts, and being

*See F. W. Farrar. The Early Days of Christianity, London, 1882, Chaps. XII.–XIV.

made complete by them; the number three being a half of it, and the number two a third of it, and the unit a sixth of it, etc. . . . It was fitting, therefore, that the world, being the most perfect of created things, should be made according to the perfect number, namely, six."*

"But after the whole world had been completed according to the perfect nature of the number six, the Father hallowed the day following, the seventh, praising it and calling it holy." † "And it (the number seven) is honored by those of the highest reputation among both Greeks and barbarians, who devote themselves to Mathematical Science."‡ He also speaks of the "beauty" and "divine dignity" of number seven, and gives at great length certain astronomical, musical, arithmetical, geometrical, and physiological reasons for that significance; he also mentions in the same connection Solon's division of human life into periods of seven years.

In the year 415 Augustine devoted a chap-

* Philo Judæus, De mundi creatione secundum Mosen, Transl. by C. D. Yonge, London, 1854, Sect. III.

† Ibid., Sect. XXX.

‡ Ibid., Sect. XLIII.

ter in one of his treatises on Genesis to what he calls "The perfection of number *six*."*

He divides numbers into these three classes, the less than perfect, the perfect, and the more than perfect, according as the sum of their even quotients is less than, is equal to, or exceeds the original number. Thus 4 may be divided into $\frac{2}{2}$ and $\frac{4}{1}$, but $2 + 1 =$ only 3, and 4 is therefore less than perfect; 12 may be divided into $\frac{12}{1}$, $\frac{3}{4}$, $\frac{4}{3}$, $\frac{2}{6}$, and $\frac{6}{2}$, but $1 + 4 + 3 + 6 + 2 = 16$, and 12 is therefore more than perfect; but 6 may be divided into $\frac{6}{1}$, $\frac{2}{3}$, $\frac{3}{2}$, and $1 + 3 + 2 = 6$, and therefore 6 is a perfect number. Six is the first number in the series in which this occurs, the next one being 28. Then he argues: "We must not say, therefore, that six is a perfect number because God perfected his works in six days, but that God perfected his works in six days because six is a perfect number."†

In regard to number *seven* he writes: "For if, by the number six, the creature was to be perfected as it was perfected, and

* De Genesi ad Litteram, Lib. quartus, Cap. II. De senarii numeri perfectione.

† Ibid., Lib. quartus, Cap. VII. § 14.

that rest of God was to be commended to us, which rest would be shown to be *unblessed with perfect creatures*, undoubtedly *the day which follows the sixth* was the one *to be made blessed* by this commendation." *

Dr. Bæhr, "evangelical" pastor at Eichstetten in Baden, in 1837, published a very instructive book on "The Symbolism of the Mosaic Worship," † in which he says: "It is an historical fact that there was no nation of antiquity which did not make a symbolic use of single numbers and forms as well as of number and measure in general. Everywhere, among every ancient people, especially in the East, do we meet with an important science of numbers, most intimately connected with religion and worship. This fact is accounted for by the views of the world peculiar to all ancient peoples, which held the real as inseparable from the ideal, indeed, as its image and revelation." ‡ He gives the general reason for the use of number and measure in the smallest details of the taber-

* Ibid., Lib. quartus, Cap. XVI. § 28.

† Symbolik des Mosaischen Cultus, von Karl Christ. Wilh. Fel. Bähr. 2 vols. Heidelberg, 1837. A 2d edit. of Vol. I. appeared in 1874.

‡ Ibid., Vol. I. Cap. II. § 2, pp. 129–131.

nacle: "If it was to be an image of the great world-building of the entire creation, and particularly as far as the same is a witness and revelation of God, so the first and most important requisite was that it should be exactly defined by number and measure, that it should be measured throughout. For that quality of being measured is the proper divine element in and of the world, on account of which it is a witness, a revelation of God. And this definiteness as to number and measure was made prominent because this aspect of the creation was especially regarded in the tabernacle. Just this first gave the tabernacle its character as a place of divine revelation."* And he then proceeds to give the significance of the different numbers which entered into the plan of the tabernacle: three, four, seven, etc.

Three. "The world has three parts, the heaven, the earth, and sea; . . . time moves as a whole in past, present, and future, and in general every true whole in space and time has a beginning, middle, and end, so that the tripartiteness of all things was a recognized fact with the ancients." † "As Mosa-

* Bähr, Vol. I. Cap. II. § 1, p. 128.
† Ibid., p. 142.

ism uses *three* to designate all perfect being, and therefore every *whole* one which has beginning, middle, and end, so three and thrice are used, here as everywhere else, in a proverbial sense. Whatever is to be done rightly, wholly, perfectly, occurs three times. Thus Jonathan tells David to come on the *third* day, when he will shoot *three* arrows; Joseph incarcerates his brothers *three* days; the darkness which Moses invoked over Egypt lasted *three* days; *three* times a day was prayer offered (Ps. lv. 17, and Dan. vi. 10); Jonah remained *three* days in the fish, and Christ arose on the *third* day. But since the idea of oneness in connection with the idea of perfection coincided at first necessarily with, indeed, to a certain extent, was alone and originally the same as the idea of God, so thrice in Mosaism is the sign of the divine Being and of everything which stands immediately connected with Him or depends upon Him."*

Four. "Four is the number of the elements and of the regions of the earth; and as all immeasurable space so every space extends itself in four directions; therefore

* Ibid., p. 156.

the existence of a body necessarily implies four dimensions. Four is, therefore, in general the number of corporality. But this number likewise underlies all divisions of time, morning, noon, evening, and midnight; and the year divides itself into four seasons."* Four winds are commonly spoken of.

Seven. "As three is the symbol of Divinity, and four the symbol of the world, the significance of seven grows out of both. As three and four come together in seven forming one number, it is the sign of the union of God and the world. . . . The two conceptions of God and the world imply all religion: no matter how different their relation to one another may be, all religion revolves around them; and the aim of religion, on the whole, is union, communion with God. While all symbolical numbers, as far as they indicate divine and human relations, and are used in any way for purposes of worship, are called in a general sense sacred numbers, seven is specially and in a proper sense *the sacred* number."†

Now turning to Gen. i., we find the crea-

* Bähr, Vol. I. Cap. II. § 1, pp. 155, 156. See also Moses Stuart, Com. on Apocalypse, Andover, 1845, Vol. II. p. 421.

† Bähr, Vol. I., Cap. II. pp. 187, 188.

tion of 8 (2×4) objects or groups represented as taking place in 6 (2×3) days:—

DARKNESS. THE SPIRIT OF GOD BROODS UPON THE WATERS.

1st Day.	LIGHT (day), separated from darkness (night).	1st Work.
2d "	FIRMAMENT, separating the waters underneath from those above.	2d "
3d "	EARTH, separated from the seas.	3d "
	VEGETATION: Tender grass. Herb yielding seed. Fruit tree yielding fruit.	4th "
4th "	HEAVENLY BODIES, to lighten the day and the night.	
	Sun to rule the day. Moon to rule the night. Stars also.	5th "
5th "	WATER AND AIR ANIMALS.	6th "
6th "	LAND ANIMALS: Cattle. Creeping animals. Beasts of the earth.	7th "
	MAN.	8th "
7th "	GOD RESTED OR CEASED.	

The singular position of vegetation, separated as it appears from the rest of the organic creation by the heavenly bodies, points to a peculiar notion of classification, and probably falls in with some numerical symbolism. We are, therefore, justified in drawing a line between the third and fourth day and the fourth and fifth work. Perhaps the most reasonable explanation of this arrangement is that the author, adopting the current poetic conception of his time, regarded the heavenly bodies, on account of their movements, as in some sense

animated beings.* Thus Ps. xix. 6 compares the sun to a bridegroom, Judges v. 20 represents the stars as fighting in their paths against Sisera, Job xxxviii. 7 speaks of them as singing together, Isa. xl. 26, and xlv. 12, represent the heavenly bodies as an army marshalled by the Highest, and Gen. ii. 1, which forms part of this cosmogony, refers to "the host" of the heavens, and so also does Ps xxxiii. 6. If this view be correct, the works of the first three days belong to the *inanimate or motionless*, those of the remaining three to the *animate or moving creation.* But as each section comprises four works, and as four is the symbol of corporality or of the world, so each section would stand for a world-body, the one inanimate, the other animate, and the three days assigned to each division would indicate the completeness of the time.

The days are (2×3) 6. What was done well and thoroughly was done three times, and twice three times emphasizes that significance. Thus Joseph, in interpreting Pharaoh's dream, says: "And for that the dream was doubled unto Pharaoh twice; it is because the

* This is from E. E. Riehm, Der biblische Schöpfungsbericht (a lecture), Halle, 1881, pp. 6, 7.

thing is established by God, and God will shortly bring it to pass." (Gen. xli. 32.) It is also probable that six possessed a significance of its own. One explanation of this is given by Philo and Augustine, as quoted above; but its purely mathematical character seems rather remote for popular usage, although the meaning they assign to the number seems reasonable. Six often occurs in connection with seven, and we may, by examining their relations, be able to determine the significance of the former. In Job v. 19 we read: "He shall deliver thee in six troubles, yea in seven there shall no evil touch thee." In Ezek. xlvi. 4 we find: "And the burnt offering that the prince shall offer unto the Lord in the sabbath day shall be six lambs . . . and a ram." In Numb. xxxv. 6 six cities of refuge are appointed. In Exod. xxi. 2: "If thou buy an Hebrew servant, six years he shall serve; and in the seventh he shall go out free for nothing." Also in Exod. xxv. 31, 32, the plan of the candlestick is given: six branches with one central light; Jericho was compassed six times in six days, and seven times on the seventh day. When, on the seventh round of the seventh day, the seven

priests who preceded the ark had blown on the seven trumpets, the walls fell; and so in this chapter we have six days and a seventh. If seven denote harmony between God and man, that is, what is religious and sacred, we shall not be far from the truth if we infer from the use of six in the above passages that it signified completeness, sufficiency, or divineness with special reference to the earthly, the secular, the natural. Thus interpreted the passage in Job would read: 'In the greatest temporal troubles He shall deliver thee, yes, even in the greatest moral danger no evil shall touch thee.' The law in regard to the liberation of slaves would signify on the one hand the completeness of the discharge of the debt of servitude, on the other the sacredness of liberty. The six branches of the candlestick may symbolize the perfection of God's creation; the seventh, His moral perfection or holiness. It was the sacred power of *seven* as distinguished from the completeness of *six* which tumbled the walls of Jericho. In like manner the six creative days bespeak the completeness of the time and the divine character of the work, while the seventh indicates its moral or religious consummation.

Have we not, then, in this cosmogony an illustration of the Oriental fondness for numerical symbolism? Is not this work characteristic of that type of mind to which was committed, or which devised the numerical plan of the tabernacle and its worship? Is not this method of interpretation in accord with the genius of inspiration?

It is a well-known and interesting fact that the purest and truest of all natural religions, the Zoroastrian, had a cosmogony divided into *six* periods, corresponding to the *six* seasons of the Persian year, to which were assigned successively the creation of the heavens, the water, the earth, plants, animals, and man. That religion also divided the history of the conflict between the good and the evil divinities into two periods of 3,000 years each. The numerical and other resemblances between these two cosmogonies are suggestive of their common origin, and the facts certainly indicate the prevalence of the use of the numbers *three* and *six* in ancient religious systems. The numbers six and seven occur also in the Babylonian narrative of the flood.

But we are told that "in six *days* the Lord

made heaven and earth, the sea, and all that in them is." What are these much bewritten days? That the word "day" signified, first of all, a solar day is evident from its use in the Sabbatic commandment, "Six days shalt thou labor and do all thy work" Did the author, then, intend to use it in the same sense when he adds: "For in six days the Lord made heaven and earth"? If the language be regarded as of equal authority as the commandment with which it is connected, and so intended to convey to us the divine thought, it must have had a symbolical meaning, although its form may have been adapted to the infantile intellect of the race; "for the divine Scriptures have the habit of transferring words concerning human things to divine ones." * Augustine renders this passage: "In six *human* days do all thy work; for in six *divine* days the Lord made heaven and earth." In other words, as God, after a period of creative activity perfectly commensurate with the vastness of His work, nature, entered upon an era of sacred rest, so man, made to be the reflex of his Maker, ought, after finishing

* Augustine, De Genesi contra Manichæos, Lib. I. Cap. XIV. § 20.

all *his* work, the week of daily toil, to devote his Sabbath to a similar rest. The emphasis of the passage is not on the time but on the moral end in view; and the metaphorical use of the word "day," in reference to the Creator, only makes this more forcible. The analogy is between God's example on an infinite scale and man's duty on a finite one.

> "As the work to the work,
> As the rest to the rest,
> So are the times to the times." AUGUSTINE.

The question here naturally arises whether the ancient Hebrews understood the six days in any such sense. It is certain that the Westminster divines did not. To this it may be replied, granting that the Hebrews took the same view of the matter as the authors of the Catechism: these would not be the only cases in which both the Jewish and the Christian church have fallen into the errors of the "letter," and failed to seize the "spirit" of Revelation.

With the aid of these general observations we are prepared for a more minute examination of the cosmogony.

Without stopping to discuss the question whether the first verse contains simply an

epitome of the events described in the following verses or an account of the origin of matter itself, preliminary to the history of its formative development,* it is sufficient for our present purpose to notice that the "making" of the visible cosmos is here ascribed to God, the personal cause of causes; and in the nature of His relation to the world a broad foundation is laid for the moral law. Chaos is described as a deep with darkness resting upon it; the Spirit of God moved or brooded upon the face of the waters, "and God said let there be light and there was light." To a person familiar with the outward aspect of nature the most important thing in the cosmos would naturally seem to be light, and the separation of light and darkness appear as the first step in the introduction of order; moreover, it would appear that the Hebrews regarded light as separate from the sun. Thus Job xxxviii. 19, 20: "Where is the way where light dwelleth? and as for darkness, where is the place thereof that thou shouldest take it at the bound thereof, and that thou shouldest know the paths to the house thereof?" and also xxvi. 10: "He hath compassed the waters

* See Dillmann, Genesis, pp. 15, 16.

with bounds until the day and night come to an end."* Hence its place in the cosmogony, which happens to coincide with that assigned to it by modern physical discoveries and theories. But that this is not revealed science is evident from the use of the words "day" and "night" in the same connection, and from the number of nights and days (evenings and mornings) occurring before the creation of the sun; for the separation of "day" and "night" in the phenomenal sense involves the existence of planets revolving around fiery suns; and these planets must have passed out of an incandescent condition into a solid and dark one before the existence of night was possible. So that if the night of the fifth verse is to be understood phenomenally, either the sun must have been in existence (but that only appeared on the fourth day) or else the Hebrews thought of light and darkness, day and night, as independent of the sun, which is the correct view. Thus the passage speaks of daylight without regard to its physical source, just as, a little beyond, vegetation is considered apart from, indeed before, the light

* The same idea recurs in Ps. lxxiv. 16: "Thou hast prepared the light and the sun."

and heat which were its indispensable precursors. Infinite Wisdom looks with complacency upon His works, as we read in the fourth verse, and the evening and the morning, that is, the beginning and the ending, constitute the first day. The commencement of the solar day was fixed at different times by different nations. With some it began at sunrise, with some at noon or midnight, and with still others, including the Hebrews, at sunset. Hence the inverted order here.

The attention of the ordinary observer of nature would next be drawn by the sky. This was evidently regarded by the author and by the ancient Hebrews as a vast crystalline or metallic dome.* Thus Ex. xxiv. 10: "And they (Moses, Aaron, etc.) saw the God of Israel: and under his feet as it were a paved work of a sapphire stone, and as it were the body of heaven in clearness." Also Job xxxvii. 18: "Hast thou with him spread out the sky, which is strong, and as a molten looking-glass." (Often the conception was as of a curtain or tent, as in Is. xl. 22, Ps. civ 2)†

* From Dillmann.

† See Tayler Lewis, op. cit., p 53, for an explanation of this beautiful Hebrew conception of sunrise and sunset.

This dome rested upon the highest hills, called "the pillars of heaven." Thus Job xxvi. 11: "The pillars of heaven tremble and are astonished at his reproof"; and 2 Sam. xxii. 8: "Then the earth shook and trembled; the foundations of heaven moved and shook, because he was wroth." Above this dome were waters (Ps. cxlviii. 4): "Praise him, ye heavens of heavens, and ye waters that be above the heavens." This dome (firmament, expanse) was introduced in the midst of the waters of "the deep," and made a separation, some remaining above it, some below, forming the terrestrial seas, and the atmosphere occupying the intervening space. The dome was provided with windows, "the windows of heaven" which being opened let down the superincumbent water as rain.* It is difficult to determine whether these were mere forms of speech or real conceptions of the constitution of nature, for there are other passages in which the rain is described as coming from the clouds. Thus Job. xxvi. 8: "He bindeth up the waters in his thick clouds; and the cloud is not rent under

* Gen. vii 11, viii. 2; 1 Kings viii. 35; 2 Kings vii. 2, 19; Ps. lxxviii. 23; Mal. iii. 10.

them";* and xxxvi. 27, 28: "For he maketh small the drops of water: they pour down rain according to the vapor thereof; which the clouds do drop and distil upon man abundantly." But here would come in also the question of the respective age of these different conceptions of nature.

Then "the waters under the heaven" are separated from the land, and "earth" and "seas" are formed, but there are yet waters "under the earth." †

Then vegetation appears, including fruit trees; that is, the highest kind of vegetation. This alone makes a scientific interpretation impossible, for plants, with rare exceptions, require light and heat to sustain the chemical action involved in their constitution; but we have it distinctly stated, if we apply a scientific standard to the language, that fruit trees, which belong to the highest order of plants, flourished prior to the existence of the source of heat and light, or, which is substantially the same, prior to the present relations of the earth to the sun. Some have

* See also 1 Kings xviii. 44, 45, and Job xxvi. 7, which are scientific enough for ordinary language to-day.

† Gen. vii. 11; xlix. 25; Exod. xx. 4; Ps. xxiv. 1, 2; cxxxvi. 6.

striven to meet this difficulty by supposing that the making of the great lights and setting them in the firmament of the heaven do not refer to the beginning of their existence, but to their first appearance to a supposed observer on the earth as the mists which enveloped the planet cleared away. But this explanation only raises other objections; for, as just stated, we learn from the twelfth verse that the highest kind of vegetation, that is, plants requiring sunlight to attain to perfection, flourished before these events; but according to the geological record these plants did not appear until a relatively recent period, the later Cretaceous and Tertiary, so we have to suppose that the sun was not visible until the approach of Tertiary times, which, in view of the long series of plants and animals which existed before that time, is highly improbable. This difficulty as to vegetation is sometimes met by supposing that the author, being aware that some obscure plants could subsist in the dark, introduces vegetation before sunlight, and then overlaps events by continuing this thread of his narrative to its end in the perfection of the vegetable kingdom in recent

times. But it may be urged that this knowledge ought also to have restrained him from writing so unscientific a history; and, by supposing him to have knowingly perpetrated so gross an anachronism, we do violence to the simplicity and tenor of the narrative, and we also undermine its religious value. It is noticeable, in this connection, that the Persian cosmogony, which some scholars date as far back as 1500 B. C., places the creation of vegetation in its natural position.

We have now reached the end of the third day. The process thus far has been mainly a series of separations: light from darkness, waters terrestrial from waters celestial, earth from seas; the earth then brings forth vegetation.

On the fourth day sun, moon, and stars are set in the firmament to divide between, and rule the day and the night, to be for signs, seasons, days, and years, and to give light upon the earth. On the first day the separation of day and night took place; *the lighting of the day and night* is now provided for.

On the fifth, aquatic animals and birds.

On the sixth, mammals and creeping animals, beasts of the earth, and also finally man,

to whom is given dominion over the animals; and in verse 27 we read: "So God created man in His own image, in the image of God created He him, male and female created He them"; that is, not only was man distinguished from animals by his superior intellectual endowment, but he was also given a moral nature resembling that of his Maker, and thus is allied to the divine.

Thus in these six symbolical days, that is, in a succession of times *completely* adequate, the *perfect* heavens and the *perfect* earth, distributed into two groups representing the inanimate or motionless and the animate or moving creations, each complete in itself and of divine workmanship, were finished and all the host of them.

And on the seventh symbolical day, indicating what is *sacred*, that is, the ideal moral harmony between God and man, God consummated His work and entered, we may infer, upon the higher spiritual activities which the moral government of the souls He had called into existence imposed upon Him.

In the following table the Bible and the scientific cosmogonies are placed side by side for comparison. The latter is based upon the

nebular hypothesis, which is as scientific as any theory in reference to the earlier history of the cosmos, and upon the geological record which is well ascertained and valid for the later history of our planet.

The numbers in both tables indicate the relative, but not the corresponding order of events in each account.

The letters in the tables of vegetable and animal life indicate both the relative and corresponding order.

BIBLE COSMOGONY.	SCIENTIFIC COSMOGONY.
1. Light.	1. Chemical activity. Motion, heat, and light.
2. Seas and atmosphere.	2. Sun (Solar system).
3. Continents.	3. Earth formed.
4. Vegetation, including flowering plants.	4. Moon formed.
5. Sun, moon, and stars.	5. Earth solidifies and cools. Day and night begin.
6. Aquatic animals and birds.	6. Seas and continents.
7. Land animals, cattle, and creeping animals.	7. Vegetable and animal life begin.
8. Man.	

ORDER OF THE APPEARANCE OF LIFE.

Vegetable.	*Animal.*
a. Seaweeds.	*a.* Lowest forms.
	b. Mollusks, corals, crustaceans.
c. Ferns and pines.	*c.* Fishes.
	d. Reptiles and birds.
e. Flowering plants and palms.	*e.* Mammals.
	f. Man.
8. Man.	

In comparing these, we notice on the one hand the difference between the order of the appearance of the sun and of vegetation, the latter occurring, according to the Bible account, not only before the sun, but even in its highest forms, before all animal life, whereas in fact the highest forms of vegetation did not appear until long after fishes, and but a very short time before mammals. On the other hand, there is a marked similarity in the order of the appearance of fishes, reptiles, mammals, and man, as well as in the first appearance of light.

It is evident that the two accounts cannot be parallelized. The one was manifestly written largely with only the aid of such a knowledge of nature as may be obtained by looking abroad at the sky with its orbs, and at the sea and land with their familiar animals and plants. The other is the result of the patient and laborious researches of many minds during scores of years. The one was written from the standpoint of the sacred poet, and with the aims of the religious teacher; the other, from that of the student of natural law. Nor does this statement do violence to the integrity of the author; for

it is only an assumption on the part of his readers that he intended to give, or supposed himself to be giving an absolute revelation of natural history. The facts are the same in both accounts, but their arrangement is different. In the one they are made to form a series of images, and contribute significance to a system of numerical, religious symbolism; in the other they are placed in their natural and historical sequence.

Several important features of the cosmogony remain to be noticed. As we have interpreted the days and the numbers symbolically, so we shall find ourselves obliged to treat the divine fiats. On this point, Augustine remarks: "And when they hear, 'God said, let it be made, and it was made, they conceive of words begun and ended, sounding in time, and passing away, after whose departure, that came into being which was commanded so to do, and whatever, of the like sort, men's acquaintance with the material world would suggest. In whom, being yet little ones and carnal, while their weakness is by this humble kind of speech carried as in a mother's bosom, their faith is wholesomely built up, whereby they hold

assured that God made all those natural objects which in admirable variety their eye beholdeth around." (Confessions.) There were occasions in the history of our planet when either a new force was introduced or a new law instituted, as for instance when life began or when man appeared; and between such events there must have been vast periods of time during which the forces previously set in motion were, under a God-given impulse, accomplishing their appointed task, and the time was ripening for the institution of some higher law. And such a series of periods of growth, alternating with moments of creation, is aptly and beautifully symbolized in the oft-recurring words: "And the evening and the morning were the first day," "And God said let there be and there was"; but this is figurative language. According to Tayler Lewis the evening and the morning typify that cycle of growth and decay which all natural and religious processes seem to follow, and which, when complete, calls for a new life.*

Again we have the wonderful adaptations and mechanisms, the adornments of Nature,

* Op. cit., p. 241.

and her perfect obedience to law, signified in those words, "And God saw that it was good," with perhaps an implied contrast to man's disobedience and the moral disorder which sin brought.*

There is one remarkable fact about this account. It describes to us in grandly simple traits a progression of events: first matter, secondly vegetable life, thirdly animal life, and lastly man, endowed with mind and conscience. And when we study the page of nature, we find the same events in the same general order.

The following paragraphs embody opinions on the cosmogony from very different sources: —

Hæckel, a pronounced unbeliever in a personal God: "Two great and important fundamental-ideas of the natural development theory stand out with surprising clearness and simplicity in the creation hypothesis of Moses: the idea of *separation* or *differentiation* and the idea of *progressive development* or perfection. Although Moses looks upon these laws . . . as the immediate

* See Löhr, Die Geschichte der heiligen Schrift vom Anfang der Dinge. Berlin, 1851.

agency of a Creator, still there lies concealed in his account the higher idea of a progressive development and differentiation of originally uniform matter. We can, therefore, pay to the magnificent understanding of nature shown by the Jewish lawgiver and to the simply natural language of his hypothesis of creation the tribute of our just and sincere praise, without seeing in it a so-called divine revelation."*

Tayler Lewis: "In Genesis as in Revelation there is the same impression of a strange chronology that cannot be measured by any historical or scientific scale out of its own movement. It is like distance in a picture. It is there, but we cannot bring it either into miles or inches. It has succession; height appears beyond height, but there is no estimating the valleys, the immense valleys, it may be, that lie between."†

Augustine: "I should have desired, verily had I then been Moses, . . . and been enjoined by Thee to write the book of Genesis, such a power of expression, and such a style, to be

* E. Häckel, Natürliche Schöpfungsgeschichte, 5th ed., Berlin, 1874, pp. 34, 35.

† Lange, Genesis, Am. edit., 1869, Special Introduction to Chap. I. p. 155.

given me, that neither they who cannot yet understand how God created, might reject the sayings, as beyond their capacity, and they who had attained thereto, might find what true opinion soever they had by thought arrived at, not passed over in those few words of Thy servant; and should another man by the light of truth have discovered another, neither should that fail of being discoverable in those same words." (Confessions.) This, taken in connection with Hæckel's remark, is very suggestive.

The author of the "Vestiges of the Natural History of Creation": "I freely own that I do not think it right to adduce the Mosaic record, either in objection to, or support of any natural hypothesis; and this for many reasons, but particularly for this, that there is not the least appearance of an intention in the book to give philosophically exact views of nature."*

Löhr, pastor in Zirchow, calls attention to its parallelism and symmetry. The light-bearers of the 4th day corresponding to the light of the 1st day, the water and air animals of the 5th to the water and air of the 2d, the

* American reprint, New York, 1845, p. 119.

land animals of the first part of the 6th to the land of the first part of the 3d, and, finally, the man of the close of the 6th to the plants of the close of the 3d day — the highest of the animate to the highest of the inanimate creation.* Further on he says: "This story, doubtless, originated intuitively. With justness to its character, it may be said to reproduce the impression which the world made upon the childlike man of primitive times, before his penetration had as yet been utterly obscured by sin. The story is a product of that primeval Chokmah, or wisdom, which saw things as they were, which knew all things, of course without yet knowing that it knew them; and which, in course of time, lost itself, and became confined to a few chosen ones, until in Israel it again found a home and finally blossomed out in Solomon and his time."†

Dr. Riehm: "In the interest of Bible-faith it should be finally admitted, without reservation, that he who seeks information as to the external course of the formation of the world must address himself not to the Bible, but to

* Op. cit., p. 35.
† Ibid., p. 39.

the naturalist. Not secular knowledge but the truth of faith, is to be sought here."*

Robertson: "Moses had not a scientific message to deliver; but the marvel is this, that there is not one spiritual fact that can be overturned. The cosmogony of the Phœnicians was atheistical; so was that of the Egyptians; in North America the Indians have a cosmogony not atheistical, but simply ludicrous. Now comes the question, how is it that out of all these cosmogonies one only is found that stands the test of great scientific principles? Science declares that the God of the universe is a God of order, that there has been gradation in the growth of the world, that there is unity at the root of variety. Moses declares so also in the simple, childlike language of those days before science had existed."†

Dillmann: "Numerous attempts have been made to bring the physical portion of the Bible story into accord with the results of natural science. These can only at the utmost be carried out in a general way, not in detail. . . . The favorite expedient at present

* Op. cit., p. 16.

† F. W. Robertson, Notes on Genesis, London, 1876, Lecture I.

is to combine the formation-periods postulated by geology with the six days of our account, in such a way as to change the days into formation-periods of indefinite duration. This theory depends at the outset upon a change of the meaning of 'day,' but even thus fails to make out any agreement between the geological periods and the six creative days; for (aside from the definite number six) the ancient animal worlds, according to paleontological facts, did not disappear *after* the ancient plant worlds, but *together with them*, while according to Gen. i. 10, 12, the formation of the earth and the development of plants were finished and sealed by the word of divine approval before any animals appeared." *

All these facts and opinions point to the symbolical and poetical method of interpretation as the true one. Thus interpreted the creative week becomes like the apex of an angle which is as small as you please, but whose diverging limbs enclose infinite space. All the discoveries which science has made and will make in the realm of nature, all the scientific libraries and museums of the world

* Dillmann, Genesis, pp. 10, 11.

are but illustrations and more ample disclosures of the truth set forth in those simple words. If we desire to know what they dimly set forth we must turn to God's unwritten word, and master its secrets with that intellect by virtue of which man received from Him dominion over nature.

The object and the province of the author of the cosmogony were :—

First. To proclaim the existence of God, the "maker" of the world.

Second. To assert the moral nature of man.

Third. To lead man, therefore, to worship God instead of nature.

Fourth. To establish the Sabbath as a means for the development of man's moral nature.

Fifth. Then, subordinately, to illustrate the perfection and the order of nature as the workmanship of infinite Wisdom.

In view of the fallen state of man and his consequent proneness to worship the creature, these sublime truths needed to be held up before him, and especially before the Jews, who had emerged from centuries of bondage to a nation which worshipped the sun and

various animals as representatives, if not as impersonations of gods;* and to them above all others, because they were the conservators of the truth which, in its fuller development, was to redeem and renovate the world.

The practical religious power of this portion of the Bible, at the present day, is well illustrated by an incident mentioned by Rev. Thomas Hill in an article on this chapter: A Japanese or Chinese young man in New York had never heard of God until he read of Him in the opening verses of the Bible, when at once the truth dawned upon him, and all the mystery of his life and of nature found a perfect explanation in the one God. He began, from that moment, to worship Him.† Thus is this Scripture "profitable for instruction in righteousness," as well as rational in its import.

But if we adopt the usual method of interpretation we shall involve ourselves in difficulties from which no amount of scientific or theological ingenuity will suffice to extricate us.

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* See Deut. iv. 19, 20.

† Bibliotheca Sacra, April, 1875. Ex-President Hill there treats Gen. i. as strictly religious in its character and aim, while poetic in its style.

The views of this paper may be summarized in these words: The Bible cosmogony, as contained in the first thirty-four verses of the Book of Genesis, was written with an ethical-religious aim by an author whose religious nature was divinely inspired. Whoever may have been the author of its traditional or written form, Moses believed and taught its main ideas, and the promulgator of the moral law was thus in so far also the historian of the institution of physical law. The language is phenomenal, Oriental, and symbolical. Phenomena are described according to primeval conceptions of nature, entirely unaided by a science of nature, either inspired or uninspired. Not that there might not have been a revealed scientific cosmogony, just as we have in some parts of Scripture revealed future history, but the facts show that such a cosmogony was not given to us, and it would be easy to adduce reasons for such a revelation having been withheld. On the other hand, the account contains suggestions of general laws as well as remarkable agreements with nature as to a great series of facts, which would seem to indicate an insight into the general methods of God in nature, or at least are a strong testi-

mony to the genius of the author as the simplicity of his style is to his literary skill. And the extraordinary exercise of these intellectual gifts may safely be attributed indirectly to religious inspiration. Thus Milton described in "Paradise Lost" a nebula long before such a thing was known, and foreshadowed the nebular hypothesis: — *

"A dark,
Illimitable ocean, without bound,
Without dimension; where length, breadth, and highth,
And time, and place, are lost; where eldest Night
And Chaos, ancestors of Nature, hold
Eternal anarchy, amidst the noise
Of endless wars, and by confusion stand.
For hot, cold, moist, and dry, four champions fierce,
Strive here for mastery, and to battle bring
Their embryon atoms."

. . . . . .

"Chaos umpire sits,
And by decision more embroils the fray,
By which he reigns: Next him, high arbiter,
Chance governs all. Into this wild abyss
The womb of Nature, and perhaps her grave,
Of neither sea, nor shore, nor air, nor fire,
But all these in their pregnant causes mix'd
Confus'dly, and which thus must ever fight,
Unless the Almighty Maker them ordain
His dark materials to create more worlds."

. . . . . .

"*Some tumultuous cloud*
Instinct with fire and nitre" (Second Book.)

* Simon Newcomb, Popular Astronomy, 4th edit., New York, 1882, p. 503.

What classic learning and a consecrated imagination did for the author of "Paradise Lost," Chaldean or Egyptian learning and native genius, guided by a divinely inspired moral nature, may have done for the author of the cosmogony.

The element of divine inspiration in the first chapter of Genesis must be sought, not in any revelations it makes of nature, but in the sublimity of its religious truths: "In the beginning God created the heavens and the earth," "God created man in His own image," truths which, like a gold and silver thread, run all through the fabric of Revelation.

Its wonderful simplicity, born of a time when men looked upon nature with less of analysis than of "thoughtful, meditative wonder," and the divine truth which breathes through its imagery and symbolism, stamp it with those intellectual and religious characteristics which distinguish the Scriptures from ordinary writings, and command for them our reverence and admiration.

THE

VITAL QUESTIONS IN THE CONFLICT

BETWEEN

RELIGIOUS AND PHYSICAL SCIENCE.

TO CREATIONISTS AND EVOLUTIONISTS.

"*How came she there, that majestic shape, jewelled in ideas —jewelled in ideas, were they but shells of the shore, or simple heath bells of the most savage moor?—That is it, all has been duly developed from an atom, but whence are the ideas — the ideas of the vast resultant organization?*"

JAMES HUTCHISON STIRLING, *The Secret of Hegel.*

"*For the invisible things of him since the creation of the world are clearly seen, being perceived through the things that are made, even his everlasting power and divinity.*"—ROMANS I. 20.

"*Till at the last arose the man,*
Who threw and branch'd from clime to clime,
The herald of a higher race,
And of himself in higher place,
If so he type this work of time,
Within himself, from more to more."

IN MEMORIAM, cxviii.

WHILE to the devout heart and the enlightened mind there is, and can be no conflict between Christian faith and physical science or between goodness and wisdom, whether as elements of the divine character revealed to us through Jesus Christ and through nature, or as reflections of the same in the character and works of men, no one can go far without perceiving that our *conceptions* of things religious and things physical, that is, our religious and our physical science, are far from being in harmony.

During the last two or three decades so much has been said and written on "the conflict between science and religion," as it is now popularly termed, that one is not only surfeited with the quantity of matter, but somewhat bewildered by the multiplicity of issues presented.* It is well, therefore, to inquire what fundamental and practical questions underlie all this writing, lecturing, and sermonizing. An endeavor to state these candidly and clearly may throw some light upon the true method of their solution.

But as the spirit of men largely determines their philosophy, and a certain current of thought underlies all thinking, let us first consider, what are the directions of these opposite currents?

On the one hand, the representatives of Christianity, looking steadfastly at the moral and religious side of man, consider him chiefly in his relations to a future existence and an unseen God; "for the things which are seen are temporal, but the things which are not seen are eternal." The existence of this

*Prof. Ch. W. Shields, in his Final Philosophy as issuing from the Harmony of Science and Religion, an Historical and Critical Introduction, 2d edit., New York, 1879, affords the general reader invaluable aid in reviewing and systematizing the conflicting views.

Being and His claims upon the obedience and love of men have, along down the ages, been affirmed by numerous miraculous manifestations, and even our every-day Christianity was ushered into the world by the testimony of those who had witnessed the miracles and the resurrection of Jesus Christ. Christian families from childhood up are thus made familiar with the miraculous method of divine operation, and early learn to look upon even the ordinary phenomena of nature somehow as the immediate effects of a divine activity. It is not surprising, therefore, and in view of the one-sidedness of the human mind, that a tendency exists to unduly emphasize the supernatural, and that the slower and seemingly less direct mode of divine government in nature should not be as fully recognized as its universality requires. Indeed, it would be easy to trace the pernicious effects of an undue supernaturalism among the more ignorant classes of Christians, especially in the less enlightened sections of our country, at all those points in the individual and social life where religious faith has anything to do with nature.

On the other hand, the student of nature

looks at man chiefly on the physical side, in his relations to the physical world, and, indeed, as forming a part of it; he looks upon nature simply as a vast and complex piece of mechanism which, as far as his observation extends, acts in accordance with a certain uniformity which he denominates natural law. His pursuits and intellectual habits dispose him to look everywhere for law governing impersonal forces.

It is evident that a problem in nature submitted to the consideration of two persons who had each come mainly under the influence of one of these schools of thought might easily receive two entirely different interpretations. The one would be inclined to call to its solution the supposition of creative interpositions; the other would look no further than the operations of natural force under natural law. To take an extreme case, one would ascribe the origin of species to supernatural acts, somewhat like that which provided wine at the wedding in Cana; the other would ascribe it to a process of mere natural selection; and, proceeding to more general questions, the one would make all nature supernatural, the other would eliminate the

supernatural from the universe.* The effects of these tendencies are, in the one case, ignorance of nature, both as the revelation of the divine intellect and that with which our earthly existence has immediately to do, and also little understanding of the intellectual problems which some sincere minds, students of nature, experience in forming their religious conceptions, and, in the other case, ignorance of the vast moral problems and possibilities, of whose very existence the supernatural is to us both the evidence and the only solution. Such views, carried to their logical results, would lodge the Christian in a narrow scepticism as to God's relation to nature, and the scientist in atheism of thought and life.

These conflicting tendencies express themselves in the following vital questions: —

A. Is there a personal Mind behind these forces and laws?

B. Is there a Providence ruling human life?

C. Is prayer effective?

D. Is a miracle possible?

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* See on "The Ideas of Nature and the Supernatural as presented in the Scriptures," by Tayler Lewis, in the Special Introduction to Lange's Commentary on Genesis (Am. edit.), New York, 1869.

But the same conflicting tendencies meet in another issue which comes home to every one. This question concerns only indirectly the existence of God, but has to do with the moral existence of man, and has arisen from the study of his physical constitution and of animal life in general.

E. Is man anything but the highest type of vertebrate life? Is he physically descended from the brutes, and to be classified with them?

Thus, on the one side, we have the existence of God, and, on the other, the immortality of the soul questioned, and find ourselves brought to the edge of an awful abyss of thought. All that generations have lived and died for, the highest, tenderest, and holiest of human hopes, would be replaced by the despair of a soulless cosmos.

The grounds for these doubts are so familiar as hardly to need mention:

A. It is claimed that all the phenomena of nature may be ultimately traced to the operation upon matter of a few correlated forces (if not to a single force), which always act and have acted in obedience to fixed laws; and that it is in nowise necessary, in order to account for our universe, to suppose the exist-

ence of a Creator; that these forces, in their interactions and evolutions and transmutations, are all-sufficient to produce all the complex phenomena which excite our admiration.

B. It is claimed that this uniformity in nature is opposed to the doctrine of a personal Providence in human affairs.

C. And therefore to the doctrine of prayer, as far as prayer has anything to do with them.

D. That in consequence of these negations there is no supernatural, and all accounts of miracles must be the relics of an age of gross ignorance and superstition, or else myths which in the course of centuries have obtained their present form and credence.

While it is by no means proposed to bring the resources of theology and philosophy to combat all these propositions, — a work which belongs to the theologian, — it may not be misjudged to consider some of them in the light of modern physical science and of so much of theology as appears to be sustained by it.

A. The profound study of Nature in all her departments, it is acknowledged, reveals a vast system of forces and laws which in the

last analysis prove to be few and simple.* As we follow the history of nature we find that it consists of a series of stages, — the inorganic, organic, and human; and not only do these manifestly constitute a progression, but each in itself is a progression as shown by the history of our planet, of vegetable and animal life,† and of the human race. These statements, especially those relating to the inorganic and organic stages, are borne out by the following well-known facts: The law of gravitation, as formulated by Newton, is the perfection of simplicity, but infinitely complex and far reaching in its effects. It affects the remotest planet as well as the paper upon which these lines are printed; the same may be said of the law of chemical attraction which governs the atoms of the fiery gases in the sun as well as those of the pebble at our feet; or of the law of cell-growth which is concerned alike in the structure of the gigantic Sequoia and in the smallest spot of mould. The discovery of the correlation of motion,

*Wm. R. Grove, The Correlation of Physical Forces, 1st edit. London, 1846. John Tyndall, Heat a Mode of Motion. London, 1863. Herbert Spencer, First Principles. London, 1862. Josiah P. Cooke, Modern Chemistry. New York, 1875.

† Herbert Spencer, Principles of Biology. London, 1864-7.

heat, and light has greatly simplified our conceptions of physical force, and the revelations of the spectroscope have given us a new view of the universality of chemical and physical laws.* The lower plants, like the Bacteria, Desmids, and Diatoms, and the lower animals, as the Monera, Rhizopoda, and Infusoria, are almost homogeneous in composition, and very simple in structure, while the higher are heterogeneous and complex. In the lower orders of plants and animals the life of the individual is sometimes merged in that of the community, as in the Lichenes among plants, the Spongida, Hydrozoa, Actinozoa, and Polyzoa among animals, whereas in the higher orders, among both, individualization becomes more complete. In the lower orders one organ often performs several functions, as in the cuttlefish, where the siphuncle acts both as an organ of locomotion and of aëration for the gills, as in Limulus, the horseshoe crab, where the legs subserve both locomotion and mastication; in the Rhizopoda, where respiration, digestion, and locomotion are performed by the surface of the body, or as in the Confervas

*H E. Roscoe, Lectures on Spectrum Analysis. London, New York, 1869.

among plants, where identical parts are organs of fructification and vegetation; but in the higher organisms we have that more perfect division of labor, of which our own bodies are the best illustration. During the earlier geological ages the flora and fauna, although large, were neither of the highest order nor, as a whole, of the greatest diversity, their greatest perfection and variety having only been attained in later times. Thus Cryptogams and Gymnosperms were the highest plants of the Paleozoic, while the Angiosperms appeared only during the later Mesozoic and the Cenozoic; and among animals we have, during the Paleozoic, Protozoa, Articulata, Mollusca, Radiata, Pisces, and Reptilia; but not until Mesozoic times did Aves and Mammalia appear, while Man began to be only in late Tertiary or Post-Tertiary times.* The mineral, the plant, the animal, and the man, or, taking their constitutive and representative units, the crystal, the cell, and the soul, typify the history as well as the constitution of nature. The genius of Nature may then be said in general to attain vast results by simple means, — to proceed, both in time and

* See Scientific Cosmogony, in essay on Genesis, p. 104.

space, from the simple to the complex, from the uniform to the multiform, from the homogeneous to the heterogeneous, from the general to the special, from matter to life, from life to spirit. Its course is a progression of force, of law, and of form, ending in a *being* possessing intellect, feeling, and will

Such a system must needs commend itself to every philosophical mind. Similar characteristics or ideas on a dimunitive scale in the work of an artist, architect, poet, or philosopher would be regarded as evidences of the genius of the workman; but as in nature the Workman conceals both his personality and his instruments, we refuse to accept evidence which on the lower plane of art we consider conclusive.

In this connection some interesting analogies between architecture and nature deserve notice. James Ferguson, in his "History of Architecture,"* remarks: "So far as we can judge, the human body is the most perfect of Nature's works. In it the groundwork or skeleton is never seen, and though it can hardly be said to be anywhere concealed, it is only displayed at the joints or more prominent

*London, 1865. Vol. I., pp 34, 35.

points of support, where the action of the frame would be otherwise unintelligible. The muscles are disposed not only where they are most useful, but so as to form groups gracefully rounded in outline. The softness and elegance of these are further aided by the deposition of adipose matter, and the whole is covered with a skin which with its beautiful texture conceals the more utilitarian construction of the internal parts. In the trunk of the body the viscera are disposed wholly without symmetry or reference to beauty of any sort, the heart on one side, the liver on the other, and the other parts exactly in those positions and in those forms by which they may most directly and easily perform the essential functions for which they are designed. But the whole is concealed in a perfectly symmetrical sheath of the most exquisitely beautiful outline. It may be safely asserted that a building is beautiful and perfect exactly in the ratio in which the same amount of concealment and the same amount of display of construction is preserved, where the same symmetry is shown as between the right legs and arms, where the parts are applied to different purposes, and where the same amount of ornament is

added, to adorn without interfering with what is useful. In short, there is no principle involved in the structure of man, which may not be taken as the most absolute standard of excellence in architecture. . . . So instinctively, but so literally, has this correct process of imitating Nature been followed in all true styles of architecture, that we can always reason regarding them as we do with reference to natural objects. . . . A Cuvier or an Owen can restore the form and predicate the habits of an extinct animal from a few fragments of bone, or even from a print of a foot. In the same manner an architect may, from a few fragments of a building, if of a true style of architecture, restore the whole of its pristine forms, and with almost the same amount of certainty. This arises wholly because the architects of those days had correct ideas of what was meant by imitation of Nature. They added nothing to their buildings which was not essential; there was no detail which had not its use, and no ornament which was not an elaboration or heightening of some essential part, and hence it is that a true building is as like to a work of Nature as any production of man's hands can be to the creation of his Maker."

McCosh and Dickie, in their work on "Typical Forms and Special Ends in Creation,"* remark on the converse of this truth that of the architectural principles of Convenience, Symmetry, Euarythma, and Ornament "not one is wanting in the architecture of Nature."

Although it has been claimed, and perhaps with some reason, that the argument from design involves an assumption, it will certainly be granted that there are remarkable contrivances and appliances in nature, and that these are *strongly indicative* of a similarity between the designing power in nature and that in mechanical art. The fundamental laws of architecture are, mechanical, artistic, and decorative design. The first regards the utility of the structure, the second its general æsthetic qualities, and the third its accessory decoration. Buckland, in the sixth volume of the Bridgewater Treatise, long ago showed how perfectly the law of mechanical design was exemplified in the shell of the Nautilus and the Ammonite; but much remains to be said on the exemplification of the laws of artistic and decorative design in the

* First Am. edit., New York, 1856.

shells of the Ammonitidæ. The laws of artistic design are, Unity, Contrast, Euarithmy, Proportion, Symmetry, and Harmony.*

The law of *Unity* requires that the structure have "one end, one design, one comprehensive use, but also that each part should have all its parts so disposed that they may be regarded as one."

The law of *Contrast* requires diversity, variety, richness, resting, however, on unity.

The law of *Euarithmy* requires a limit to the multiplicity of parts.

The law of *Proportion* requires proportion between the parts and the whole, based either upon a mathematical principle or upon the nature of the material and the object of the structure.

The law of *Symmetry* requires symmetry between the different like members.

The law of *Harmony* requires that the rational ground for adopting any one dimension should govern in the adoption of every other dimension, except so far as the special case calls for different treatment.

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* These classifications and definitions are taken from the short manual of Henry N. Day, Science of Æsthetics. New Haven, 1872.

Now applying these principles in the study of the shells of the Ammonites, we find that they are all exemplified: *Unity* in the prevalence of the same design throughout each shell; *Contrast* in the diversity and richness of the lines formed by the several whorls, ribs, collars, or keel; *Euarithmy* in the general simplicity of the designs; mathematical *Proportion* between the diameter of the whorl at any given point and its distance from the centre;* *Symmetry*, both bilateral and concentric; *Harmony* in the dimensions of the ribs and nodes which only vary as the size of the whorls.

Decorative design is also exemplified in the very great variety of designs of the ribs, which in different species or groups are circular, serpentine, broken, or forked, of the nodes, which vary in height, shape, and position, and also of the minute striæ and corrugations of the surface.†

It may be objected that the architectural

* This has been formulated in the case of the Nautilus. See H. G. Bronn, Die Klassen und Ordnungen des Thier-Reich's, Cephalopoda 1860.

† A perusal of Alcide D'Orbigny's Paléontologie Française (Céphalopodes), Paris, 1860, or of some of the numerous German monographs on Ammonites, or an examination of a paleontological collection, will serve to verify these statements.

principles traced in the shells of the Ammonites are but the natural results of the interaction of the force of gravitation and the efforts of the muscular tissues of the mollusk, together with the alternating periods of growth and rest to which these animals are probably habituated, all affecting the direction, amount, and form of the calcareous secretions of the mantle.* But even if it be conceded that the mollusk works instinctively after no pattern, and that the action of two or three forces, operating according to well-known laws, alone suffice to produce a structure responding to the highest demands of architectural art, we shall still find ourselves compelled to admire the result, and shall recognize yet more the *mind quality* of that which by means so simple could produce effects so complex and beautiful. Organisms with geometrical forms necessarily afford simpler illustrations of architectural principles than those with curvilinear outline; but for the latter the same truth holds, as Ferguson has shown for

*See Alpheus Hyatt, Transformation of Planorbis at St Imier, with Remarks on the Effects of Gravity upon the Forms of Shells and Animals, Proc. Am. Ass. Adv. Science, Vol. XXIX. p. 527. Salem, 1881.

the human body, and as could easily be shown for nearly all plants and animals.

When man thus imitates the very spirit of Nature we regard it as an evidence of a high degree of personal intelligence; but when, and by dint of much study, we discover the methods which prevail in nature, we regard them simply as self-originated properties of matter, or results of "natural selection," or at best as the operations of "an Unknown Reality, symbolized by matter, motion, and force." No one doubts that the fallen column or the broken frieze once expressed the thought of an architect, nor do we hesitate to find in the evolution of the various styles of architecture evidences of mind; but the fossil Saurian and Cephalopod, with their wonderful mechanisms and ornamentations, are mindless products, and the evolution of the great types of life was without an Evolver! As well might we claim mechanical knowledge for the mason's trowel, and genius for the sculptor's chisel, as to ascribe Nature solely to the forces at work in her. Thus the Sciences of Nature having exhibited the *ideas* which underlie and pervade nature, and failing to perceive the logic of their own discoveries,

would trace those ideas back to a mindless, if not to a material source.

There are two significant passages in Butler's "Analogy," bearing directly on this subject:—

"The only distinct meaning of the word natural is stated, fixed, or settled; since what is natural as much requires and presupposes an intelligent agent to render it so, *i. e.*, to effect it continually or at stated times, as what is supernatural or miraculous does to effect it for once."*

"Men are impatient, and for precipitating things: but the Author of nature appears deliberate throughout his operations; accomplishing his natural ends by slow successive steps. And there is a plan of things beforehand laid out, which, from the nature of it, requires various systems of means as well as length of time in order to the carrying on of its several parts into execution. Thus in the daily course of natural providence, God operates in the very same manner, as in the dispensation of Christianity; making one thing subservient to another; this to some-

* This was quoted by Darwin on the first leaf of his Origin of Species.

thing further; and so on, through a progressive series of means, which extend, both backward and forward beyond our utmost view. Of this manner of operation, everything we see in the course of nature is as much an instance as any part of the Christian dispensation."

Chalmers, in the introduction to the first volume of the Bridgewater Treatise, observes also: "Now it is a commonly received, and has indeed been raised into a sort of universal maxim, that the highest property of wisdom is to achieve the most desirable end, or the greatest amount of good, by the fewest possible means, or by the simplest machinery. When this test is applied to the laws of nature, then we esteem it, as enhancing the manifestation of intelligence, that one single law, as gravitation, should, as from a central and commanding eminence, subordinate to itself a whole host of most important phenomena, or that from one great and parent property, so vast a family of beautiful consequences should spring."

This is also Berkeley's idea in his "Alciphron," where, after showing that from motion we infer a mover or cause, and so from

reasonable motions a rational cause; and then, contrasting the insignificance of human actions and works with the greatness of the universe, he deduces the incomparable greatness of its rational Cause, and proceeds thus:—

"Is there not in natural productions and effects a visible unity of counsel and design? Are not the rules fixed and immovable? Do not the same laws of motion obtain throughout? The same in China and here, the same 2,000 years ago, and at this day? . . . Is there not also a connection or relation between animals and vegetables, between both and the elements, between the elements and heavenly bodies; so that, from their mutual respects, influences, subordinations, and uses, they may be collected to be parts of one whole, conspiring to one and the same end, and fulfilling the same design? . . . Will it not then follow that this vastly great, or infinite power or wisdom must be supposed in one and the same Agent, Spirit, or Mind; and that we have at least as clear, full, and immediate certainty of the being of this infinitely wise and powerful Spirit, as of any one human soul whatsoever besides our own?" *

* George Berkeley, Alciphron, 1732, edit. by A. C. Frazer, Oxford, 1871, Vol. II. Dial, iv. pp. 143–145.

But since the days of Chalmers, Butler, and Berkeley, how greatly have the evidences of the unity and rationality of nature multiplied! These are, indeed, the very features in the modern doctrine of "Evolution" which give it its intellectual fascination, but which some erroneously regard as shutting God out of nature, while in reality they are the best evidence of "His power and divinity." *Thus the "Unknown Reality" of Mr. Spencer declares the rationality of His being through the evolution of the "matter, motion, and force which symbolize" Him.* This argument, like all arguments from analogy, may fail to compel assent. It is possible for a man to silence the logic of his natural intuitions, and to insist upon more or different evidence than the nature of the case admits of; and in the end many a one chooses for himself some hypothesis as the basis of his thinking and living, and prefers to determine for himself by the result of his own life-experiment whether his philosophy shall be found true to the constitution of the universe or a mere reflection of his own desires.

B. In reply to the claim that the uniformity of natural law is opposed to the doctrine

of a personal Providence in human affairs, it may be observed: —

1. That the uniformity of natural law is perhaps not as fully recognized by theologians as it ought to be. Certain it is that many Christians look for providential deliverances in cases where a little more knowledge of nature would have convinced them that only one issue was possible, and that one in accordance with well-known laws of nature.

2. That this indisposition to recognize the law element in nature exists also with reference to religious truth. A less dogmatic but more scientific study of the Scriptures, of the human spirit, and of God's dealings with His children, shows that righteousness and love are underlaid by great principles or laws having their roots in the divine character, and as fixed in their nature as are moral and physical laws. Indeed, it is the element of perfect uniformity or law which lifts these virtues into divine attributes; and in like manner, Christian character itself becomes established and powerful only in so far as it approximates to the same uniformity. Thus the realm of law, as the student of nature understands it, instead of being con-

fined to the sphere of the natural, really extends to and pervades the sphere of the spiritual. The kingdom of Christ has its laws just as the kingdoms of mind, life, or matter. These laws of the Spirit may be as mysterious as the laws of the winds used to be, but they are none the less real or potent.

3. The correlation of moral and physical law is seen in the moral and physical disorders which follow reciprocally the transgression of certain moral or physical laws; and that correlation not only largely corroborates the religious teachings of Moses and Christ, and thus Christ's teachings in regard to divine Providence, but it also effects a just providence in human affairs.

4. Not only is there law in the sphere of religious truth, and correlation between moral and physical law, but natural and revealed truth are related throughout by analogy. This is Butler's idea (really an ancient Scripture idea), but it admits of a wider and modern application.

Horace Bushnell, in his "Dissertation on Language,"* has a suggestive remark on this subject: "What is Christian truth?

* See volume entitled God in Christ.

Pre-eminently, and principally, it is the expression of God, — coming into expression through histories and rites, through an incarnation, and through language, — in one syllable, by the Word. The endeavor is, by means of expression and under the laws of expression, to set forth God, — His providence and His government, and, what is more and higher than all, God's own feeling, His truth, love, justice, compassion. It accords, also, with this, that, while natural science is advancing with so great rapidity and certainty of movement, the advances of mental science are so irregular and obscure, and are wrought out by a process so conflicting and tortuous. There is, however, one hope for mental and religious truth, and their final settlement, which I confess I see but dimly, and can but faintly express or indicate. It is, that Physical Science, leading the way, setting outward things in their true proportions, opening up their true contents, revealing their generic and final causes and laws, and weaving all into the unity of a real universe, will so perfect our knowledge and conception of them that we can use them in the second department of language with more exactness;

. . . for, undoubtedly, the whole universe of nature is a perfect analogon of the whole universe of thought or spirit. Therefore, as nature becomes truly a universe only through Science revealing its universal laws, the true universe of thought and spirit cannot sooner be conceived. It would be easy to show, in this connection, the immense force already exerted over the empire of spiritual truth by astronomy, chemistry, geology, the revelations of light and electricity, and especially of the mysterious and plastic workings of life in the animal and vegetable kingdoms."*

The Great Teacher himself constantly makes use of nature as a language to convey spiritual truth; and it is the perfect naturalness of His analogies which distinguishes them from the artificial "illustrations" of many a sermon; for instance, His analogy between the organic physical connection of the vine and its branches and fruit, and the organic spiritual union of Himself and every child of God. In the same spirit Paul com-

* See D. A. Wasson, in North American Review, October, 1868, Epic Philosophy, which treats of the world of things as signs and symbols of moral, metaphysical, or spiritual insight. Some of Swedenborg's writings lie in a similar direction, but, although containing truth, can hardly be termed always sensible.

pares the resurrection of the body to the germination of the seed of a cereal. Many have been the applications made in recent years of the Theory of Evolution to religious truth. Thus the Bishop of Carlisle has a lecture on the "Gradual Development of Revelation";* and the same method has been successfully applied in other departments of religious truth.† But all these analogies lie deeper than mere rhetoric or a chance resemblance between the facts of nature and religion; they indicate *similarity and oneness in the constitution* of the moral and natural world. And, the truth of this being once grasped, what a key to wisdom it becomes in the hands of both the naturalist and the religious teacher!

5. This analogy and unity throw light on

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* Modern Scepticism; a course of lectures delivered at the request of the Christian Evidence Society. 3d edit. London, 1871.

† See Dr. W. Woods Smyth, The Bible and Evolution, 1873; also an abridgment, entitled The Government of God, London, 1882; Henry Drummond, F. G. S., Natural Law in the Spiritual World, London, 1883. Neither of these works was known to the writer when these essays were written, although the thought of one or two passages in this paper will be found to be almost identical with that of Mr. Drummond's work. His idea is not that of *analogy* between either the phenomena or the laws of the natural and the spiritual world, but *identity of law* through both realms; and this he illustrates in several papers which are as fascinating in their freshness as they are practical in their character and aim.

the question of a divine Providence. Thus in nature we find *the principle of subordination*. The substance of the plant is composed of elements which form compounds, cohere, move or crystallize according to ordinary chemical and physical laws. If left to themselves, these substances would form part of the atmosphere, the water, the rocks, and the soil; but they are brought under subjection to biological law,* and thus combine in the structure of a plant of a certain dimension and form. The crystal in the cell of the plant crystallizes according to mineralogical law, but its presence in a vegetable cell is due to biological law. Biological law marked out the channel in which mineralogical law should be executed. The chemical composition of the substance of the plant is strictly a chemical one; the movement of the sap through the cell-walls is strictly a physical process; but the structure to which these contribute, the organism with its morphological characteristics, and its power of reproduction is not the product of mere chemical and

* This term is used here to distinguish that particular *law* which governs whatever *force* is concerned in the formation and multiplication of cells and their combination in a structure provided with different members performing various functions.

physical processes. The analogous thing occurs in animal life, in the intellectual life, and the moral life. The laws of animal life, subordinating chemical and physical laws, and even utilizing the products of vegetable life, build up the human organism; but this organism obeys the intellect as in writing, or in painting, music, speech, etc. The mind, again, while obedient to the laws of reason, serves the moral nature according as thought is used to promote good or bad ends. There is thus all through nature the element of subordination to increasingly higher laws.* Now in turning to the life of men, we can easily see how it is possible for each one to act on his plane and in the integrity of his own volitions, and yet for the channel of his actions to be marked out for him by a superior power, a divine Mind. This is in strict conformity to nature. Thus it is possible for God to order not only the events of each man's life, but of society as a whole. Thus He rules in the history of men and of nations.

C. If God is thus the supreme Ruler of

* Mark Hopkins bases his moral philosophy upon the law of subordination in the universe. Lectures on Moral Science. Boston, 1862.

events, we may infer that He rules in conformity with the laws of His righteous and benevolent character. Therefore, we may further infer that prayer, when offered to Him in conformity with the laws of His character, the laws of mind, and of nature, may have a reasonable expectation of being in due time answered. This is a rational and scientific foundation for prayer.*

D. We have considered some of the reasons for a belief in the existence of God, in His providence, and in prayer. He thus would appear as both the Evolver and Ruler, the beginning and end of the universe. If He is that, *He could* put forth the same creative energy which He must have put forth when these forces were set in motion and these laws instituted. We have but to suppose some end sufficiently high and good and rational to believe that *He would.* The institution of the Spiritual kingdom of Jesus Christ as a means of lifting men up out of spiritual and moral degradation into a new life, and the revelation to them of the reality

*See also James McCosh, The Method of Divine Government, Physical, and Moral, Chap. II., On the Providence of God. New York, 1851.

of a higher stage of existence hereafter, answer such conditions. But these questions are in the province of theology proper.

We now come to the second great question, — that which involves the moral and spiritual nature of man, the other factor of religious truth.

E. As long as it was generally conceded that man, physically as well as morally, was created by supernatural means, it was inferred that his destiny was immortal; for, although it was supposed that plants and animals originated in the same way, it was assumed that the arbitrary Power which brought him and them into existence gave him a nature and a destiny distinct from the rest of "creation." But now that naturalists have endeavored to demonstrate man's physical descent from some highly developed, extinct, animal species, the question has arisen whether there is any essential difference between man, physically or morally, and a mere animal. If the difference is simply one of degree, then physical death would appear to end human existence, and therefore terminate its moral value.

But what are or were the grounds for

believing that the progenitors of the human race were made by direct, supernatural means? The mind at once reverts to the Old Testament, to the testimony of the moral and intellectual consciousness, and to the numerous objective indications of man's superiority to the animal kingdom.

On the other hand, what are the grounds for the theory of physical descent?

1. It is argued, in reply to the Old Testament doctrine, or that which has been popularly current as such, that the idea of miraculous creation is not conveyed by the passages in question; that natural as well as miraculous processes may be described by the language used. Thus we have the long and slow, successive eras of geological history described in the same Scriptures under the figure of a few solar days. Why may not, therefore, the complex processes of nature by which physical man was evolved and made ready for his spiritual endowment be portrayed to us by the words which have been rendered "made," "formed," and which would seem to apply literally only to the work of an artisan. The figure in the one case harmonizes perfectly with that in the other. The possible correct-

ness of this view, and, indeed, of the symbolical character of much of the Biblical story of the infancy of the race, has long been admitted by some devout Biblical students. Thus Tayler Lewis remarks: —

„ In this part, then, of our argument, all that we need contend for is that the origin of man, as man, was special and peculiar. By this we mean, his distinctive humanity, as separate from all he has in common with the lower natures. We are not much concerned about the mode of production of his material or merely physical organization. In regard to this, there is nothing in the expressions 'He made,' or 'He created him,' or 'He made him from the earth,' which is at war with the idea of growth, or development, during either a longer or shorter period. Ages might have been employed in bringing that material nature, through all the lower stages, up to the necessary degree of perfection for the higher use that was afterwards to be made of it. We do not say that the Bible teaches this; we do not think that any one would be warranted in putting any such interpretation upon it. There is, however, in itself, and aside from any question of

interpretation, nothing monstrous or incredible in the idea that what had formerly been the residence of an irrational and groveling tenant might now be selected as the abode of a higher life, might be fitted up in a manner corresponding to its new dignity, might be made to assume an erect, heavenward position, whilst it takes on that beauty of face and form which would become the new intelligence, and, indeed, be one of its necessary results. The glorified body of Christ, which is now in the highest heaven, is linked in its origin with our frail, physical, material humanity. He took our nature into himself. The moral and theological bearings of the two cases may be widely different, and yet the physical connection involved in the latter is not less wonderful, to say the least, than any that might be imagined to exist in the former case. A former physical growth might thus have been taken up into a new life. From an old organism there might thus have been made a *new man*. On this head, however, the Bible gives us no distinct information. . . . And yet, be this growth or physical origin whatever it may, — be its mode ever so much controlled by the laws of

an antecedent nature, be its duration longer or shorter, — it does not at all necessitate the conclusion which some pious minds would so much dread. It does not make *man himself* a growth, a development. Humanity proper, or the human proprium, did not *grow*, was no work of Nature, but had a divine, a supernatural, an instantaneous beginning. There was a time, a moment, when man — *a* man — the *primus homo*, began to *be*, who a moment before *was not*. There was one in whom humanity commenced, and from whom all subsequent humanity has been derived. There was one who first began to be a man, and this principium has its date from the first energizing of that higher life which came from a direct inbreathing of the Almighty and Everlasting Father of Spirits."*

Hermann Ulrici, in his great psychological work, "God and Man,"† chiefly directed against modern materialism and atheism, while demonstrating in many ways that there is a radical distinction between the human body and soul, still admits the possibility and

* Tayler Lewis, The Six Days of Creation, or the Scriptural Cosmology, 2d edit., Schenectady, 1855, pp. 248-250.

† Dr. Hermann Ulrici, Gott und der Mensch, Part I., Leib und Seele, 2d edit., Leipzig, 1874, p. 118.

the rationality of the theory of man's physical descent. He remarks: "In other respects we do not at all oppose the theory of descent in general, but only the Darwin-Hæckelian, purely mechanical conception of it, which shuts out all governing *plan* and *design;* and we believe in the prevalence of a universal principle of structure and development, both in the inorganic and organic realms, which, immanent both in mineral substances and in organic structures, has governed from the beginning in harmonious, systematic, and designful form, and in accordance with which the manifold rock species as well as the various organisms have arisen respectively from* and after each other in a progressive order, from the lower to the higher, forming and developing themselves"

2. According to the theory of the economy of divine energy, it may be assumed that, if physical man could by any process of nature have been evolved, there would have been no occasion for, and therefore no probability of, the exercise of any miraculous power.

* Ulrici ought to have omitted the word "from" in his definition. It implies more than the facts seem to warrant.

3. Admitting all that the human consciousness, all that the Scriptures, all that mental and moral philosophers have claimed for the spirit of man, as to its independent existence, its present and future moral capability, its immortality, all this may yet be consistent with the natural origin of *physical* man.

Thus much negatively. Now, positively, the grounds for accepting the theory of the physical descent of man are, briefly stated; and this will furnish occasion for presenting some of the later and maturer views of specialists on evolution in the animal kingdom.

4. It has been demonstrated by eminent naturalists that species of plants and animals do vary to a certain extent under the influence of artificial and natural environment and the instinct of self-preservation, so that the term "species" is no longer to be considered as denoting a fixed, but a variable, quality.*

5. It has likewise been demonstrated that not only does the nature of the environment determine to a certain extent the character

* Charles Darwin, The Variation of Animals and Plants under Domestication, London, 1868; On the Origin of Species by Means of Natural Selection, London, 1859. Alfred R. Wallace, Contributions to the Theory of Natural Selection, London, 1870.

of the species, but that the sexual instincts play a part in determining its modifications.*

The laws of heredity, by which species tend to reproduce themselves, and of variation, by which they tend to vary, are therefore opposite factors in the development of animal life.

6. It is a well-established zoölogical and anatomical fact, that, while, on the one hand, man's physical constitution is correlated to his supreme position in the animal kingdom, and in a measure to his intellectual dignity, and that, therefore, great differences exist between him physically and the highest animal of which we have any knowledge, still, on the other hand, there is far less difference between him physically and the highest animal than there is between the ape and the invertebrate type. Man's distinguishing characteristics are *primarily*, in degree, intellectual, but *absolutely*, in kind, only moral and spiritual.† It is also evident from the unity of animal life that any law of physical development which applies to the invertebrates may also be assumed to

* Charles Darwin, The Descent of Man, and Selection in Relation to Sex. London, 1871.

† See Ulrici, op. cit.

apply substantially to the vertebrates, and, if so, to the physical constitution of man.

7. The occurrence of so-called prophetic or collective types of animal life supports the theory of the physical connection of diverse types. These animals combine certain characteristics of a lower with some of a higher type, as the Dinosaurs and the Odontornithes,* which combined reptilian and avian features. (See foot-note *, page 160)

8. Retrograde development, or reversion: when ancestral features reappear in remote descendants. If these features can be referred to a lower order, they indicate decline of the race, and possible genetic relation with a lower order.†

9. Rudimentary organs: organs once used but, in consequence of long disuse, are transmitted in a mere rudimentary conditon.‡

10. Embryonic development: the embryo in the course of its development passes through

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* Othniel C. Marsh, Odontornithes; a Monograph of the Extinct Toothed Birds of North America, United States Geological Exploration of the 40th Parallel. Washington, 1880.

† Darwin, Descent of Man. Some monstrosities are probably cases of reversion.

‡ Ernst Häckel, Generelle Morphologie der Organismen. Berlin, 1866.

different stages, resembling the inferior orders of the class to which the animal belongs, and repeating also in itself the order of succession of the extinct representatives of the class in past geological times. Thus the history of the individual not only indicates the zoölogical relations of the order, but also epitomizes the paleontological history of the class.*

11. The paleontological history of the horse tribe in America as well as in Europe is a striking indication of the probability of the physical connection of the genera of that tribe, although there are doubts as to the equine character of at least one member of the series †

12. The order of the appearance of the different classes of animals in geological history forms in general a progressive series, terminating in man ‡

13. The natural and philosophical character of the theory of the organic connection of animal life is, as has already been shown, a strong argument in its favor.

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* Louis Agassiz, An Essay on Classification, in Contributions to the Natural History of the United States. Vol. I. Boston, 1857.

† O. C. Marsh, American Naturalist, Vol. VIII. p. 288; also J. D. Dana, Manual of Geology, 3d edit., 1879 p. x.

‡ J. D. Dana, Ibid., General Observations on Geological History, Progress of Life, p. 592.

All these facts and probabilities point more or less directly to some theory of evolution as the true explanation of the origin of the various forms of animal life, and therefore to the *natural* origin of man's physical nature.

These indications are, however, modified, limited, and supplemented by the following considerations: —

1. That the organizing principle which manifests itself in vegetable and animal structures is either a different force from any known chemical or physical force, or else a superior combination of those forces. That the lowest organisms arise by spontaneous generation from lifeless matter has been disproved by the most careful experiments.* Furthermore, the unit (the cell) of the vegetable kingdom is a totally different element from the unit (the crystal) of the mineral kingdom.

This is well set forth by Prof. J. D. Dana :†

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* John Tyndall, Further Researches on the Deportment and Vital Resistance of Putrefactive and Infective Organisms, from a Physical Point of View. Proceedings, Royal Society, abstract in "Nature," June 14, 1877; also his article in the "Nineteenth Century," on Spontaneous Generation, 1877-8.

† J. D. Dana, Structure and Classification of Zoöphytes, Introduction to the volume on Zoöphytes of the Reports of the Wilkes Exploring Expedition, 1846, p. 96, foot-note.

"The existence of vital force as a cause has been of late doubted, and its supposed effects attributed to mere chemical forces. . . . The single fact, often urged, that inorganic matter takes on angular forms, and organic rounded, seems to decide the question. The perfect individual, in the former, has plane faces of fixed angular dimensions, and proceeds from attractions in straight lines, having fixed mathematical relations. Solidification is, in fact, only the union of particles by these axes, which are assumed generally at the time the change of condition commences. Crystallization and solidification are, therefore, one and the same process; for the particles of a solid are always possessed of this crystalline attraction, although they may constitute together an amorphous mass. Even those so-called organic substances, which the chemist claims to have made, still show the same powers of crystallization on becoming solid. . . . But in the tissues of plants and animals, there are no planes or solid angles, except such as may result from pressure. Where, indeed, is there the slightest analogy to a crystal in an oblong cellule filled with fluids? And in the budding of cellules

from one another, and the formation of linear series, what resemblance to a solid filament of crystals? Crystals or crystalline masses are secreted by organic life; but these proceed from, and never take the place of, living cellules. There must, therefore, be some controlling influence, which prevents the particles from uniting into crystal shapes, and moulds them into growing cellules, — some power which makes the curving outline as characteristic of the organic kingdom, as straight lines and fixed angles of the crystal kingdom. This power or influence is called vitality. By it the constituent molecules of a germ are themselves controlled, and are enabled also to bring other molecules into the same living state."

It may be shown that the vegetable and animal kingdoms are not only analogous, but possibly the unequal offsprings of a common vital principle; it may be shown that the animal kingdom forms an organic whole; it may also be shown that certain inorganic forces are analogous to life, or, when combined in a certain way and subordinated to a higher law, enter into living organisms; but it has not been shown that life is identical

with and on the same plane as chemical and physical force. A new element or a new combination and subordination of old elements manifested itself on the earth when the lowest plant or animal first appeared. To account for this, Sir W. Thomson once suggested, more ingeniously than correctly, that a meteor brought the germs of life to our planet, which, in view of the heated state in which such objects must needs reach us, and in view of the fact that such an hypothesis only removes the difficulty one step further back, is very far from being a satisfactory solution of the problem.* The very readable address of Prof. Geo. F. Barker before the American Association for the Advancement of Science in 1880† is far from convincing one that there is no organizing principle in animal and vegetable organisms; for his conclusion, that "when, therefore, the chemist shall succeed in producing a substance constitutionally identical with the protoplasmic mass, there is every reason to expect that it will

* Meeting of the British Association for the Advancement of Science. Edinburgh, 1871.

† Address of the retiring President of the Association, Some Modern Aspects of the Life-Question. Proceedings, Vol. XXIX., Part I. 1881.

exhibit all the phenomena which characterize its life," leaves the morphological element entirely out of consideration. Will that artificial protoplasm proceed to construct a cell? Will that cell produce other cells, and construct an organized plant of a certain order, genus, and species?

It is thus evident that, in the first manifestation of life upon our planet, we have to do either with the introduction of a new force and the institution of a new law by supernatural agency, or else, which is practically the same thing, the evolution out of the pre-existing physical and chemical agencies of an agent which could subordinate these to its own purposes. So there was at least one point in geological history when a great innovation took place. If one, why not more? If such a change occur in the lower part of the series, the physical, may we not look for one in the higher, the psychical? Yes, when physical man "became a living soul," that is, when the moral characteristics, which distinguish him *in kind* from the brute, began to be. But we are told that man lost the crown of his primeval dignity, the spiritual life, which loss brought spiritual

> . . . "death into the world and all our woe,
> With loss of Eden, till one greater Man
> Restore us, and regain the blissful seat."

And in that remarkable conversation of Christ with Nicodemus, who may well have prefigured the modern materialist, we find these words addressed to him : "Except a man be born anew (from above), he cannot see the kingdom of God. . . . That which is born of the flesh is flesh ; and that which is born of the Spirit is spirit." Here Christ proclaims the absolute distinction between man's physical nature and that new spiritual creation which is of the Spirit ; and His language in regard to the Kingdom of God is analogous to that of science in regard to the inorganic and organic kingdoms. That which is matter is matter,— life is life. Here we find that unity of method which, Herbert Spencer says, we may expect to find after recognizing unity of source ; and this unity pervades both the moral and the physical, the supernatural and the natural.

2. It is a well-established fact that a few genera have remained unchanged from the earliest times to the present, also that species and even genera, very diverse in character,

made their appearance during a relatively short period, and, in some cases, even under general conditions of a similar character. Thus the Brachiopod genera, Lingula and Discina, occur in Cambrian rocks, and continue through the different formations up to the present.* A. Hyatt, who has made a special study of certain groups of Ammonites, observes: "We find in looking at the table that all the series sprang from one ancestral form, and that as in many other cases among Ammonoids, the genesis of the forms must have proceeded with comparative rapidity. This, of course, means not with reference to the number of years, but to the portion of geological time occupied by a series. Thus the whole of the time during which the Oolites were being deposited, was not needed in order to produce the extreme forms of the Sauzei group by evolution out of nodosum; on the contrary, one single bed contains the entire record of their existence, one minor period alone was amply sufficient for the evolution of the most aberrant form of the whole genus."†

* Karl A. Zittel, Handbuch der Palæontologie, Munich and Leipzig, 1880, Vol. I., Part IV., p. 717.

† A. Hyatt, Genetic Relations of Stephanoceras. Proceedings, Boston Society Natural History, Vol. XVIII. 1876.

Barrande, the late Bohemian paleontologist, after devoting about thirty years to the study of the fossil fauna of that country, in a chapter entitled "General Résumé: Gradual Extinction and Renovation of Specific Forms of Cephalopoda during the Silurian Period,"* stated that, in the great Silurian belt of Central Europe, there appeared eighty-four species of Cephalopoda in what he calls the "Second Fauna," and nine hundred and thirty-eight new species in the "Third Fauna," only thirty-one species of the Second Fauna having survived until the time of the Third Fauna. The eighty-four species of the Second included genera as diverse as the Orthoceras, the shell of which is a straight, elongated cone, and Cyrtoceras, the shell of which is horn-shaped. The nine hundred and thirty-eight species of the Third included Ascoceras (shell like an elongated cone bent upon itself in the middle), and the Nautilus (shell like a cone involuted in one plane, the outside whorls more or less completely enveloping the inside ones). In this connection it is to be observed

* Joachim Barrande, Distribution des Céphalopodes dans les Contrées Siluriennes, Prague, 1870, pp. 283 and 284; also Céphalopodes, Études générales. Paris, 1877.

that each of these portions of the Silurian Period covers but a fraction of geological time, and that the Nautilus has survived with but little change to the present.

3. Not only did diverse genera sometimes orginate within a relatively brief space of time, that is, evolution proceeded with unequal rapidity, but in the same genus evolution proceeded unequally. Thus in reviewing and comparing the characteristics of the two genera of toothed birds, Hesperornis and Ichthyornis, Prof. Marsh remarks: "Hesperornis had teeth implanted in a continuous groove, a low, generalized character; with, however, the strongly differentiated saddle-shaped vertebræ. Ichthyornis, on the other hand, had the primitive biconcave vertebræ, and yet the highly specialized feature of teeth in distinct sockets. Better examples than these could hardly be found to illustrate one fact brought out by modern science, that an animal may attain great development in one set of characters, and at the same time retain other low features of the ancestral type."*

4. The highly ornate character of many of the lower animals, the mathematical basis

* Loc. cit.

of their structure, as already indicated in the case of the Ammonites, points to something deeper than a mere struggle for existence or adaptation to environment. The plans of structure of the great types of life, upon which Louis Agassiz loved so much to dwell as evidence of mind in nature,* even though those plans be not necessarily, as he asserted, immediate supernatural products, point in the same direction; likewise do the mechanical principles involved in all animal structures. Therefore, granting life to be the plastic element which Evolutionists claim, there would seem to be some principle or law, aside from that involved in the mere modifications of forms, which *determines the evolution of the fundamental structures and forms themselves and also the direction of their modifications.* The interaction of such a principle with that of natural selection would be an adequate cause for the phenomena of animal life; either alone seems insufficient. Zittel, in his historic review of Paleontology,† observes on this subject: —

* Op. cit., also his Graham Lectures on the Structure of Animal Life, New York, 1866, and his Methods of Study in Natural History, Boston, 1868.

† Op. cit., Vol. I., Part I., 1876, p. 42.

"Of course opinions differ greatly as to the causes which brought about the change in species, and, indeed, which led the changes to take a definite direction. That the principle of natural selection discovered by Darwin still leaves many phenomena unexplained is no longer denied by the warmest adherents of the Darwinian Theory."

Ulrici has an excellent definition of an organism which covers the ground which the Darwinian theory does not: "Every organism is a more or less complicated system of matters and forces (of atoms as central points of all the working forces of nature), which is not only constructed with system and purpose, but also in its structure and development, as in the (original molecular) movements and functions of its parts, seems to be governed by a spontaneous force (so-called vital force) *directing itself towards certain types, and serving definite ends.*"*

5. The most satisfactory way to show both the extent and the limits of the application of the Development Theory is to apply it to the study of the extinct forms of some one group of animals, and to make as exhaustive a study as possible of them. This

* Loc. cit.

has been done in several cases with very interesting results by persons whose scientific attainments command confidence in their conclusions.

Barrande's study of Silurian Cephalopoda, already alluded to, is a work of this kind. He concluded, from the fact that new forms appear so suddenly in the geological records, and from their not belonging uniformly to the lowest genera, that the theory of development could not be maintained; that we have to do with creations, not evolutions.

Louis Agassiz concluded, from his wide studies in zoölogy and paleontology, that "all these beings made their appearance upon earth by the immediate intervention of the Creator,"* because organisms have changed, while the products of physical forces have continued the same.

In Germany Waagen,† Neumayr,‡ and Würtemberger,§ and in this country Hyatt‖

* Essay on Classification, p. 135.

† Dr. Waagen, Die Formenreihe des Ammonites subradiatus. Geog. Pal. Beiträge, Vol. II., Part II. Munich, 1869.

‡ Neumayr, Jura-studien. Jahrbuch der Geol. Reichsanstalt. Vienna, 1871.

§ Lp. Würtemberger. Studien über die Stammesgeschichte der Ammoniten. Ein geologischer Beweis für die Darwin'sche Theorie. Leipzig, 1880.

‖ Genetic Relations of Stephanoceras, and other papers in Proc. Bost. Society Natural History.

have made a special study of certain groups of the Ammonitidæ. Within these groups they have traced the gradual variation, not only in the life of the individual, but in the group itself, throughout the successive strata in which it occurs ; and they have thus been able, with some precision, even, to formulate the law which governs those variations. The great variety and wide distribution of the Ammonitidæ adds interest to these indications.

Zittel, at the conclusion of his review of the Brachiopoda, remarks : "Although numerous examples from the geological succession of a number of morphologically connected forms of Brachiopoda could be cited in support of the Theory of Descent, on the other hand it cannot be denied that the Darwinian Theory of Selection furnishes neither a sufficient explanation of the immediate appearance of numerous genera, nor of the development and chronological succession of the different families." *

Professor Alexander Agassiz has devoted much time to a work on "The Revision of the Echini." In these studies he has had

* Op. cit., Vol. I., Part IV. 1889.

a distinguished co-laborer in Mr. Percival de Loriol, of Geneva. The general conclusions to which Professor Agassiz has thus arrived in regard to the origin of the Echini he has embodied in a paper read before the Biological Section of the American Association for the Advancement of Science.* In view of the well-known anti-evolutionistic opinions of the author's father, as well as his own careful study of the subject, his conclusions carry great weight. In order to present them, it becomes necessary to quote at considerable length : —

"Since the publication of the "Poissons Fossiles," by Agassiz, and of the "Embryologie des Salmonidées," by Vogt, the similarity, traced by the former between certain stages in the growth of young fishes and the fossil representatives of extinct members of the group, has also been observed in nearly every class of the animal kingdom ; and the fact has become a most convenient axiom in the study of paleontological and embryological development. This parallelism, which has been on the one side a strong argument in favor of

* Alexander Agassiz, Paleontological and Embryological Development. Proceedings, Vol. XXIX., Part II., published 1881.

design in the plan of creation, is now, with slight emendations, doing the duty on the other as a newly discovered article of faith in the new biology.

"But while in a general way we accept the truth of the proposition that there is a remarkable parallelism between the embryonic development of a group and its paleontological history, yet no one has attempted to demonstrate this, or rather to show how far the parallelism extends. Although there is hardly a class of the animal kingdom in which some most interesting parallelism could not be drawn, and while the material for an examination of this parallelism is partially available for the Fishes, Molluscs, Crustacea, Corals, and Crinoids, yet for the illustration and critical examination of this parallelism, I have been led to choose to-day a very limited group, that of Sea-urchins, both on account of the nature of the material and of my own familiarity with their development, and with the living and extinct species of Echini. The number of living species is not very great—less than three hundred—and the number of fossil species thus far known is not, according to Zittel, more than about

two thousand. It is, therefore, possible for a specialist to know of his own knowledge the greater part of the species of the group. . . .

"It certainly has been shown to be an impossibility to trace in the paleontological succession of the Echini anything like a sequence of genera. No direct filiation can be shown to exist; and yet the very existence of persistent types, not only among Echinoderms, but in every group of marine animals, genera which have continued to exist without interruption from the earliest epochs at which they occur to the present day, would prove conclusively that at any rate some groups among the marine animals of the present day are the direct descendants of those of the earliest geological periods. . . . Such descent we can trace, and trace as confidently as we trace a part of the population of North America of to-day as the descendants of some portion of the population of the beginning of this century. But we can go no further with confidence, and bold, indeed, would he be who would attempt even in a single State to trace the genealogy of the inhabitants from those of ten years before. . . .

"But in spite of the limits which have

been assigned to this general parallelism, it still remains an all-essential factor in elucidating the history of paleontological development, and its importance has but recently been fully appreciated. For, while the fossil remains may give us a strong presumptive evidence of the gradual passage of one type to another, we can only imagine this modification to take place by a process similar to that which brings about the modification due to different stages of growth, — the former taking place in what may practically be considered as infinite time, when compared to the short life-history which has given us, as it were, a résumé of the paleontological development. We may well pause to reflect *that in the two modes of development we find the same periods of rapid modification occurring at certain stages of growth or of historic development, repeating in a different direction the same phases.* Does it, then, pass the limits of analogy to assume that the changes we see taking place under our own eyes in a comparatively short space of time, — changes which extend from stages representing, perhaps, the original type of the group to their most complicated structures, — may, per-

haps, in the larger field of paleontological development, not have required the infinite time we are in the habit of asking for them?' . . .

"Paleontologists have not been slow in following out this suggestive track; and those who have been anatomists and embryologists besides have not only entered into most interesting speculations regarding the origin of certain groups, but they have carried on the process still further, and have given us genealogical trees where we may, in the twigs and branches and main limbs and trunk, trace the complete filiation of a group as we know it today, and as it must theoretically have existed at various times to its very beginning. . . . The time for genealogical trees is passed; its futility can, perhaps, best be shown by a simple calculation which will point out at a glance what those scientific arboriculturists are attempting. Let us take, for instance, the ten most characteristic features of Echini. The number of possible combinations which can be produced from them is so great that it would take no less than twenty years, at the rate of one new combination a minute for ten hours a day, to pass them in review. Remembering now that each one of these

points of structure is itself undergoing constant modification, we may get some idea of the nature of the problem we are attempting to solve, when seeking to trace the genealogy as understood by the makers of genealogical trees. On the other hand, in spite of the millions of possible combinations which these ten characters may assume when affecting not simply a single combination, but all the combinations which might arise from their extending over several hundred species, we yet find that the combinations which actually exist — those which leave their traces as fossils — fall immensely short of the possible number. We have, as I have stated, not more than two thousand three hundred species actually representing for the Echini the results of these endless combinations. Is it astonishing, therefore, that we should fail to discover the sequence of the genera, even if the genera, as is so often the case, represent, as it were, fixed embryonic stages of some Sea-urchins of the present day? In fact, does not the very history of the fossils themselves show that we cannot expect this? Each fossil species, during its development, must have passed through stages analogous

to those gone through by the Echini of the present day. Each one of these stages at every moment represents one of the possible combinations, and those which are actually preserved correspond only to the particular period and the special combination which any Sea-urchin has reached. These stages are the true missing links, which we can no more expect to find preserved than we can expect to find a record of the actual embryonic development of the species of the present day without direct observation at the time. The actual number of species in any one group must always fall far short of the possible number; and for this reason it is out of the question for us to attempt the solution of the problem of the derivation, or to hope for any solution beyond one within the most indefinite limits of correctness. If, when we take one of the most limited of the groups of the animal kingdom, we find ourselves engaged in a hopeless task, what must be the prospect should we attack the problem of other classes or groups of the animal kingdom, where the species run into the thousands, while they number only tens in the case we have attempted to follow out?"

We have thus reviewed the ground for the different views held by Louis Agassiz and Barrande on one side, — views which are also essentially held by Principal Dawson of Montreal, a substantial contributor to geological and paleontological science, and on the other side those of Zittel, Alexander Agassiz, and several specialists. The principal reasons assigned for *Creation* are the difference in the forms and the comparative suddenness of their appearance. While these facts do militate against the Darwinian theory of Natural Selection, which requires very slow and slight changes of form and great lapses of time, they are not inconsistent with the Theory of Evolution, rightly understood, as explained in paragraph four; and they by no means necessitate an appeal to immediate supernatural causation.

In reviewing all that has been urged for, against, and in modification of the Development Theory, it may be concluded that, although the precise mode or law of development may not yet have been determined, it is safe to assume that the animal kingdom forms an organic whole, that is, that all the forms of animal life owe their origin to *some*

law or laws of development, and that man, by virtue of his physical nature, owes the origin of that nature to the same cause. On the other hand, it is in perfect analogy with the course and constitution of nature to affirm that the human spirit represents a higher element than any involved in man's physical organization, and that the new moral nature or life, which is spoken of as "born from above," and called a restoration of the divine image, represents an element still more distinct from and superior to the body. It is gratifying to see this substantially acknowledged by an eminent Evolutionist, already referred to, who, speaking from the rector's chair of a prominent German university, says: "But the value of man is not lowered by such considerations. There remains, in addition to the purely intellectual sphere, a wide domain embracing that virtue of the heart, morality, and religion, the knowledge of the ideal, in which he alone rules, and in which he raises himself far above his animal surroundings. . . . With self-consciousness not only did a new form of activity enter the world, but also

a factor unknown in physical nature — *accountability.*" *

This view of nature may seem to do away with something of the force of the old argument of design, but, really, only to replace it by stronger evidence of mind in the creation of a force and the institution of a law which, governing the constitutions of living organisms, produces, like the sculptor's hand and chisel, those same designs which were once thought to be immediate products of creative energy. Thus the successive types of life are not imperfect attempts of a divine Architect, but simply earlier stages in the evolution of a force which is slowly but surely executing His vast designs.

Thus neither *Creation* nor *Evolution* alone explains the history of the earth, but both together do; or, as Mark Hopkins expressed it long before these questions engaged so much of popular attention: "In attaining and preserving the unity and order of the universe, God's methods are two. Besides this of *addition*, there is another applicable only to organic beings, that of *development*."†

* Zittel, Über Arbeit u. Fortschritt im Weltall. Rede an die Studierenden beim Antritte des Rektorates der Ludwig-Maximilians-Universität. Munich, 1880.

† Op. cit., p. 69.

After all this, it is not surprising to find that historical students recognize these two elements also in the history of man. Thus Philip Smith, following Schleiermacher, considers that "the whole course of history is made up of distinct moments or moves, like those of a game of chess, or of a military campaign. . . . They are of two kinds — moments of origination, and moments of progress or development." *

Thus we come to presume not only that "*one increasing purpose*" but that *one method* "*runs through the ages*"; and this becomes more apparent when we review the whole field of the history of nature and of man. In the presence of matter and the action upon it of force under physical and chemical law, the process went on which finally resulted in the present physical cosmos. The introduction of "life," acting under the laws of "life," resulted in the whole vegetable and animal kingdoms. Under all these forces and laws and their interactions the earth and its physical, vegetal, and animal systems attained its present development. This progression culminated with the appearance of

* Philip Smith, A History of the World, 1864, Vol. I. p. 8.

man, rational and moral. Now going beyond natural history proper, we look through human history as the expression of his intellectual, moral, and social development. But in the appearance of Christ in the world and His resurrection we have to do with a creative event of transcendent import, and are thus permitted to stand upon the threshold of that existence of spiritual progression into which He admits those who receive Him, — an existence to which no physical standard can be applied. "For it is sown a natural body and raised a spiritual body."

In dimly showing us the mode of such a magnificent progression of events as the history of our planet affords, Science would seem to have touched the key note of the moral as well as of the intellectual and physical universe, and this seems to be borne out, even in detail, by the facts of personal life; for we find, throughout the sphere of morals and religion, laws, stages, epitomes, and designs analogous to those which characterize the physical world. Does not the religious life of the individual epitomize that of the race? Do not men and races of men in their moral history illustrate retrograde development or

reversion? Do not the plastic character of living organisms and the subtle and designful nature of life itself find their counterpart in the moral nature of man, and in the power of the Spirit renewing and fashioning it according to noble, moral, and spiritual types? And may we not reasonably expect the life of man hereafter to be characterized by processes and stages analogous to those which have governed his origin and development here? Thus the creations, the evolutions, and the cycles of the physical correspond to those of the spiritual, all alike bearing the seal of *One Master Mind;* and, in finding throughout the universe of matter, mind, and spirit *unity of method*, we are led to *unity of source*, which demands *unity in our thoughts and beliefs;* and, having yielded this, we shall perhaps willingly turn to a personal Christ for that personal knowledge of One who is indeed personally "unknowable," although so plainly discernible in nature.

For all the reasons brought forward, we conclude that physical science does afford some rational ground for a belief in the existence of God, and for a recognition of the

actual and potential moral dignity, and the immortality of man. Thus both Religious and Physical Science minister to the one Faith, and the Law of Nature but re-echoes the "Law of the Lord."

THE END.