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A table of contents for *The Expositor* can be found here:

https://biblicalstudies.org.uk/articles_expositor-series-1.php

in reality the most light-giving. A great light in life, Jesus became a greater in death, for Israel, for mankind.

“In the cross of Christ I glory,
Towering o'er the wrecks of time;
All the light of sacred story
Gathers round its head sublime.”

A. B. BRUCE.

THE FAITH OF SCIENCE.

ARE religion and science antagonistic and mutually exclusive terms? Is religion fundamentally opposed to science and science essentially destructive of religion? Within quite recent years theological and scientific journals have resounded with records of wars and rumours of wars, of alternate victories and defeats, in the battle between these combatants. And although for the moment the voice of the tumult is almost hushed, and the flag of truce waves gently on the wind, yet it is probably only a truce, and not an abiding peace, which has been arranged between these long-contending rivals. For the basis of the truce is feeling and desire rather than principle and fact. On both sides there is a benevolent wish for a clear and strict delimitation of frontier in order that each combatant may have a definite and exclusive territory assigned to it. After these boundaries have once been settled there seems to be a general hope that each party in the long conflict will severely protect its own, and honourably abstain from invading the other's territory. It appears, moreover, to be taken for granted by large numbers of persons that the proposed treaty will provide that the territory of what is called “knowledge” shall become the exclusive domain of science, and that religion shall be absolute sovereign in the territory of “faith.”

But what if no such fixed delimitation of frontier be-

tween science and religion is found to be possible? What if upon examination it be discovered that all knowledge of the positive kind is inseparable from faith, and that faith, unless it be rooted in knowledge, is not faith? What if there be no barriers of mountain ridge, or dividing current, or even discernible line between science and religion; if all attempts at the delimitation of their frontiers be as hopeless as in mid-ocean to define the boundaries of the interfluent waves, or in mid-air to assign an unalterable position to every bank in a continent of clouds? Yet, as we shall presently see, some such figure as that of intermingling clouds or interflowing waves better describes the true relation of science to religion, of knowledge to faith, than any such figures as territory and frontier, betokening, as they do, the possibility of clear separableness and definite delimitation. For the common notion that scientific knowledge is either positive or absolute is a delusion. Knowledge absolute is impossible to man. All human knowledge is relative (1) to the capacity of the knowing person, and (2) to the amount of evidence which that person possesses. But as no person is gifted with universal capacity, or is in possession of the universal evidence of all ages and all circumstances, it is obvious that his knowledge, however extensive, is yet partial; it is not universal, and therefore cannot be absolute.

The nearest approach to absolute knowledge possible to man is mathematical knowledge. Yet even mathematical knowledge is not absolute in the sense of being objectively certain without any reference to, or dependence upon, subjective capacity. To infants, *e.g.*, the rudimentary truth that twice one are two, and cannot be three, is neither a self-evident nor an absolute truth. It is necessary that the human mind should reach a certain stage in growth and clearness of perception before

the simplest mathematical truths become absolute to it. Their absoluteness, therefore, is not an absolute absoluteness, but an absoluteness relative to the stage of perceptive development. And what is more important still, it is an absoluteness, even in its maturity, wholly dependent on the assumption that the mind of man is of itself an unerring judge of truth; the assumption *i.e.* that the things which seem to man true are true. An admirable working hypothesis, no doubt; an hypothesis necessary both to thought and action, yet an hypothesis utterly incapable of absolute demonstration, or of abstract and final proof.

And the moment we leave the simplest statements of mathematics and begin to mount towards the region of its higher truths, the necessity of assumption, of making postulates, of taking things for granted, grows increasingly clear and imperative. Even the pure reason of Euclid is founded not only upon definitions and axioms which are partly of the nature of assumptions, but also upon postulates which are largely of the nature of a creed. "Let it be granted," says Euclid, "that a straight line may be continued to any length as a straight line." Here we have first to subscribe to the definition of a straight line, then to believe in the infinitude of distance, and lastly to believe that all given straight lines, and all given straight lines equally, are capable of projection into limitless infinitude. It would be interesting to know what conception the average man, with no special mathematical talent, is able to form of this fundamental postulate, upon which, together with similar postulates and definitions, the whole fabric of geometry is built, and without which Euclid's entire superstructure would instantly topple to the ground. It is evident that neither infinitude nor an illimitable straight line is demonstrable to the senses; you might

as well successfully attempt to draw the soul of man on a blackboard as a fully completed straight line. If a person has not within himself the notions of straightness, of space, and of infinitude (notions which are more or less common and clear to the generality of mankind), nothing remains for that person except to be an infidel, or an agnostic, or a sceptic with regard to straight lines and their projection to infinity, because to his senses they are wholly undemonstrable.

Without entering into the deeper questions raised by Riemann and Grassmann and Helmholtz concerning the properties of space and the fundamental axioms of geometry, it is evident to the plainest man that the axioms and postulates, and even some of the definitions in which axioms are tacitly involved, propounded by Euclid are *a priori* assumptions depending for their acceptance, not upon logical proof, but upon the nature of man's consciousness, the inevitable intuitions of his intellect, and an experimental agreement of this consciousness and these intuitions with the general course and constitution of things. Belief in the truthfulness of man's consciousness and belief in the accuracy of his intuitional notions is a necessary precedent to the building up of mathematical knowledge. Without faith, faith in infinitude, faith in universality, and faith in the exactitude of man's relation both to the infinite and the universal, it is impossible to be a mathematician. The mathematician begins with faith; the substance of his science is things invisible, and he ends with what is called knowledge, the evidence of things seen to the existence and truth of things unseen.

And if faith, or the taking of things for granted which lie beyond the range of demonstration yet fit in with observed phenomena, is necessary to pure mathematics, much more necessary is it to physical science. It is not

too much to say that faith is quite as essential to physical science as to revealed religion. The whole basis of science is a basis of faith, of the indispensable assumption of unproved hypotheses, and of believing assent to undemonstrable tenets and theories. The uniformity of nature, *e.g.*, upon which the whole framework of physical science securely rests, is nothing more nor less than a sublime assumption. It is the creed of the apostles of science, yet only a creed. No man can know absolutely what shall be on the morrow; he can foretell it, and can act on the strength of his forecast, but until to-morrow has become to-day, until the fact has verified the prediction, the prediction belongs to the sphere of prophecy—probable and practical prophecy if you like, yet still prophecy—and not absolute knowledge. Similarly with the æons of the past. Directly we reach back beyond the age of history, whether in science or religion, we arrive at the age of faith. Nature is sometimes described as a book in whose pages are written the records of prehistoric times. It is a beautiful, and probably a true, figure, because a book implies an author, and an author implies a personal mind and will. Yet it is only a figure, and a figure drawn with the pencil of faith. For as to anything which may have taken place on our planet, let us say, a million years ago, we can have no absolute knowledge apart from assumption and belief. The geologist, *e.g.*, ingeniously describes the formation of the crust of the earth, but how many unproved and unprovable assumptions does his description take for granted—assumptions not only of almost inconceivable time, but of the operations of heat, and cold, and flood, on a scale of which humanity has had no experience, and therefore cannot positively know the action. “The noble science of geology loses glory from the extreme imperfection of the record. The crust of

the earth with its embedded remains must not be looked at as a well-fitted museum, but as a poor collection made at hazard and at rare intervals.”¹ Some geologists assume that in prehistoric ages the surface of the earth was subject to upheavals and subsidences to which there are no parallels in historic times; others, that in ages of fire or ice or deluge there was still the same slow, sure, constant uniformity of operation in nature as we observe in the age in which we live. It is no part of my present purpose to discuss which of these geologic doctrines has probability on its side; I merely remark that both alike are doctrines, *i.e.*, theories requiring faith in things unseen, and beyond the reach of demonstration, as a preliminary of their acceptance. Nor does it seem to require more faith to believe that the worlds were made by God than that they were fashioned in their present form by the processes which geologists describe. Geology is as necessarily grounded in belief as Genesis, so far as the beginning of things and the formation of the cosmos is concerned.

A similar course of reasoning applies with more or less fulness to every department of material science. At the bottom all science rests on belief. The most rigorous scientific knowledge always lies under the necessity of taking something for granted. In every branch of enquiry man invariably arrives at a point beyond which he cannot logically go, and at which he is compelled to trust to assumption. To the materialist the character of matter is not more fully known than to the spiritual man is known the character of God. “No theory of the ultimate structure of matter,” writes Prof. Calderwood, “has secured general acceptance. The atomic theory is a belief, for the existence of ultimate atoms, though generally acknowledged, is not established on experimental evidence. There is a

¹ Darwin's *Origin of Species*, p. 427.

region of faith for science, as for theology, just as there must be for all ordinary exercise of human intelligence.”¹ And if the nature of matter has hitherto eluded the grasp of the human mind, far more inscrutable still is the nature of the never-resting, all-pervading energy which directs and rules the worlds—that wondrous, immeasurable, inexhaustible energy which manifests itself to man in many varieties of form—gravitation, expansion, light, heat, electricity, magnetism, and the like—but of which no one has been able to render a final analysis or ultimate account. Particles, molecules, vortex rings, indivisible atoms, fluid force, elastic solids—there is nothing in the Christian creed more intangible and impalpable, less visible and demonstrable, than these elemental assumptions of material science. The same remark holds good of æther. Æther is an assumption necessary to the maintenance of the orthodox modern doctrines of light and heat and sound as forms of motion. But no scientist can demonstrate positively and absolutely the existence of æther. All he can do is to show that the supposition of its existence is not an absurd supposition, not a supposition going against reason and the probabilities of the case; but, on the contrary, a reasonable supposition, a supposition running on all fours with observed phenomena, and interpreting and illuminating what would otherwise be unintelligible and dark. But unless the scientist had an universal knowledge of infinite possibilities he could not affirm, seeing that his æther is only an assumption, that light and heat and sound are generated and move in the manner he supposes, *and could not be generated or move in any other way*. And whatever falls short of both exclusive and inclusive demonstration partakes of the nature of belief.

And if some degree of assumption, or belief, is necessary to sciences so strict and rigid as those of pure and mixed

¹ *Religion and Science*, p. 91.

mathematics, it is still more indispensable, and in a yet higher degree, to all the sciences which pertain to life in any form. The nature of life, much more its origin, is as yet a mystery wholly unsolved. All attempts at the spontaneous generation of life from not-life have signally failed. Häckel and Schmitz have declared themselves, with an easy confidence unshared by profounder men, already able to enrol life among things comprehensible. But even they cannot count it among things creatable. Except from life, so far as our present knowledge reaches, life cannot spring. "I am convinced," said Prof. Tyndall, "that life cannot originate without life."¹ Some living germ or cell, some vitalizing protoplasm, is a precedent necessary to the generation of life. And from the mystic protoplasm which contains life no analysis, no cross-examining skill, has yet been able to charm the secret of its being. Religious persons believe that life comes from the Living God; scientific materialists believe that it comes from impersonal Nature; but both alike are compelled to use faith—the hand which lays hold of the intangible, and the eye which sees the undemonstrable, before they can apprehend the beginnings of life. No other instrument is left to them. If they refuse this, there remains for them only the blank void of agnosticism—agnosticism not only of God, but of Nature. If by "knowledge" be meant only an apprehension positive, absolute, demonstrable, then the origin of things in Nature, and very many also of Nature's processes, are as unknowable as the least demonstrable articles of religion.

It is sometimes alleged as a vice in the great argument of Bishop Butler that he lays too heavy a stress, and allows too large a scope, to the ignorance of man. Yet regarded simply as a fact, a fact patent and incontrovertible, and without reference to the inferences drawn from the fact, I doubt whether more frequent mention is made of man's

¹ Lord Tennyson's *Life*, II. 380.

ignorance and the narrow limits of human knowledge in Butler's *Analogy of Religion* than in Darwin's *Origin of Species*. I have never read any books more replete with the modesty of great knowledge, and the sweet persistence of unbounded faith, than those of Mr. Darwin. Every one is aware of his knowledge, but few seem to be equally cognisant of the strength and simplicity of his faith. Yet in one isolated respect the reading of his books is like reading Bishop Pearson on the Creed; the words "I believe" perpetually occur in them. He speaks constantly of natural selection as a "faith" or a "theory," never once as a fully established fact. After recounting some of his observations, observations of the greatest moment to his theory, he adds, "I fully believe this, though I dare not assert it positively." He speaks of difficulties appearing insuperable, of lessening them, of reconciling them with his theory, and of certain facts strengthening and corroborating his theory. But to Mr. Darwin his theory is never more than a theory. He does not claim for it the rank of a "logical deduction." All he says for it is that to his "imagination it is far more satisfactory to look at Nature" through the glass of his theory than through any other glass.¹ But if to the imagination of some other man, with an equal knowledge of the facts, a different interpretation appears preferable, what alternative is left for their differences of opinion except that with which we are so familiar in religion—the alternative of division?

The limits of human knowledge, the necessity of assumption as the ground-work of even the strictest reasoning, and the immensity of man's ignorance, are thus as obvious in the realms of biological science as in those of religion. Of course so long as biology confines itself to observation of things palpable, and experiment of things provable, and

¹ Cf. Chapter VIII., *Origin of Species*, upon which this paragraph is mainly founded.

illustration of things demonstrable, it has little need of assumption, and can get on pretty well without hypothesis; though even in this limited sphere, as we have seen, some elemental presuppositions are necessary for the establishment of the most simple inference. Yet what a narrow world the world of strictly observational science is! It is a world without ideas—a world of dissociated and chaotic particulars; a world into which the sublimities of universality, of cause, of law, of order, of contrivance, of explanation, are forbidden to enter, because the admission of any of these sublimities involves the precedent admission of hypothesis. As Mr. Darwin observes, adopting a profound remark of Mr. McLennan's, "Some explanation of the phenomena of life a man *must feign* for himself."¹ Unless a man be content to dwell in utter darkness—darkness of the intellect as well as darkness of the soul—he must feign something, take something for granted on trust, *i.e.* believe something; for without hypothesis all knowledge worthy of man, all knowledge of a beautiful, orderly, expansive kind, is unattainable. A certain, yea, a very large, degree of agnosticism all men everywhere, both religious and scientific, must be satisfied to put up with. Ignorance is an inevitable part of our common human lot. Unconscious ignorance is the lot of the foolish, conscious ignorance the lot of the wise. It is only given to great knowledge to perceive the greatness of its own ignorance. It is not until we know as much as Sir Isaac Newton that we can know, as he knew, how little we know. As a rule, the less a man knows the more he thinks he knows; and the more he knows the more also he knows that he does not know. This is true both in religion and science. It was the vastness of Bishop Butler's knowledge which led him to lay such great stress on the argument from ignorance. Similarly it was the vastness of Mr. Darwin's knowledge which led

¹ *Descent of Man*, p. 94. The italics are mine, not Mr. Darwin's.

him humbly "to make due allowance," to use his own words, "for man's profound ignorance on the mutual relations of the inhabitants of the world at the present time, and still more so during past ages."¹

And this ignorance reaches not only to the origin of things, the sources of matter and energy and life, the beginnings of mental, moral, and spiritual powers; it also comprises their present existence and operations. We know almost as little of the vital action and the ultimate interrelations of sensory and motor nerves, of the daily processes of thought, of the current motions of will, and of the constant apprehension of the authority of moral law, and the supremacy of duty, as of their primal genesis. All these are little more than words until they have been vivified and glorified by hypothesis. Then, and then only, do they become universal, majestic, sublime. It is hypothesis which interprets both the world to man, and man to himself; which quickens the universe with meaning and life; which clothes it with the glory of interest and order and law. And it comes to much the same thing in many ways—though in others being marvellously different—whether we describe an hypothesis by Mr. Darwin's word "feigning," or by the religious word "faith."

This will become still more evident if we examine the method of the generation of scientific hypothesis, or feigning. How does any hypothesis of science first come into being? In one of two ways; either by induction or deduction, *i.e.* by reasoning either from particulars to universals or from general assumptions to individual applications. All science flows either from the fountains of idea into the streams of fact, or along the rivers of fact into the ocean of ideas. Either in its origin, therefore, or its issue, science is an idea; a creation of the generalizing faculty of man. If it begins as an idea, it is a kind of inspiration,

¹ *Origin of Species*, p. 100.

a flash of light, an assumption or hypothesis shot through the mind, illuminating its inner chambers and glorifying with the enrobing beauty of order the former chaos of external things. Sometimes this inspiring flash suddenly bursts after long reflection on the subject—after (to use Newton's phrase) "long bending the mind towards the matter." It was thus that Newton discovered the law of gravitation, and Darwin the law of development. Sometimes, while a thoughtful person is brooding over one thing, the flash unexpectedly darts athwart some other thing. It was thus that Röntgen discovered the X rays. While pursuing his researches into electricity, he unexpectedly came across new properties of light, properties for which he was not seeking at the time. It should, however, be carefully noted that these flashes of discovery come only to men trained in habits of reflection. They do not illuminate the incurious, the inobservant, the thoughtless. Moreover the flash only irradiates some subject kindred, if not identical, with the subject on which a man is thinking. A man thinking of trees will not discover something of stars. To discover anything in a given kingdom of truth, a man must be thinking, and thinking of something either belonging to, or in the close neighbourhood of, that kingdom. The fact that Prof. Röntgen discovered properties of light while pondering over electricity is of itself an evidence of the close association between electricity and light. If, on the other hand, science begins with facts, the wide ingathering and systematic arrangement of facts, then the ideas of law and universality wait to follow at the end of the examination. Yet however vast the accumulation of facts, however long and careful the enquiry into them, still, unless it can be demonstrated that every fact at every time and under every circumstance comes beneath the sway, and can be interpreted by, the law inferred from the existing accumulation of facts—and can be interpreted

in no other way, which is equivalent to the demonstration of a negative—the law is only an idea, an assumption, a veritable creed, amounting to nothing more than a probability sufficient to vindicate our acting upon it.

It is obvious, however, that no length or breadth of experiment can so extend as to include universality, and exclude all other alternatives of analysis or interpretation; and thus be indisputably coincident with absolute law. Every schoolboy knows that in the physical universe there are laws counteracting laws, laws centripetal and centrifugal steadying and balancing one another, unifying laws within opposing laws—laws which dwell in the thick darkness as well as laws which are open to the light. No experiment, or series of experiments, can comprehend within its bounded scope all the possibilities of all the combinations and permutations of these multitudes upon multitudes of immeasurable laws. All that experiment can do is to prove the truth of the law as far as it—the experiment—goes, to show that it falls in with the anticipation, and that as far as it is concerned the generalization holds good and firm. Everything beyond this is hypothesis: it is what Mr. Darwin calls “feigning,” and what the Bible, in one of its various senses of the word, calls “faith.” It is the passing through the gates of the phenomenal to the regions of the transcendent; the testing of things invisible and universal by the evidence of things seen and particular.

Yet, notwithstanding its necessary reliance, in all “ultimities” and general enquiries, upon the arm of faith, nobody doubts that for all practical purposes the teachings of modern science are in many instances essentially true. What is it which gives rise to this feeling of confidence in the doctrines of science? Partly it is a trustful reverence for the true scientific temper. The true scientific temper is a modest open-minded temper—a temper ever ready to welcome new light, new knowledge, new experiments,

even when their results are unfavourable to preconceived opinions and long-cherished theories. It is a temper enthusiastically bent not upon proving things true which it has been taught to believe, but upon believing things which upon examination seem most likely to be true. It recognises that "the statement of a fact may, in nine cases out of ten, involve a theory";¹ yet its eagerness is not to establish the theory so much as to examine the fact. It is this patient appeal to the tribunal of fact which more than all else engenders confidence in the teachings of science. Science admits no ideas which are out of harmony with phenomena, no notions about things with which things themselves do not agree. It teaches that opinions which are contradicted by experiment, notions unverified by experience, doctrines that in practice will not work, are untenable. It can, indeed, occasionally give full and complete proof of its assumptions. It can say to Columbus, You believe, on the evidence of the driftage, that inhabited lands exist beyond the untraversed swellings of the Western main; go then and find them. It can say to Nansen, You believe in the existence of the polar currents and the steadiness of the direction in which they flow; in the strength of this faith leave home and wife and infant child and test this faith by the heroism of Arctic experiment. But the hypotheses of science often lie beyond the range of such complete and particular proof, as when it is dealing with measureless time and universal law. Still, even in these instances, it demands that the hypotheses shall not be contrary to reason or any known fact, but shall agree with all the facts as far as they are known, and shall be a reasonable interpretation of them. The scientific temper also demands that the door shall be always wide open for the entrance of new facts and better explanations.

This, then, is the character of scientific knowledge. It is,

¹ Dean Church's *Bacon*, p. 250.

in everything which relates to the prehistoric past and the unborn future, in everything appertaining to origins and causes, to ultimities and universalities, a knowledge based upon assumption, resting on faith. To rid itself of the necessity of faith Science would be compelled to descend from its heaven—its whole glorious upper region of law and order, of cause and effect, of the immeasurable past and the invisible future—and content itself with the little nether world of personal observations and recorded experiments and Hume's invariable sequences. To know anything, even scientifically, beyond the particular, and within the visible, faith is a prerequisite; something must be taken for granted and "feigned." No delimitation of frontier, therefore, between faith and knowledge is possible even to science without the sacrifice of the greater part of scientific knowledge—of the whole of it, indeed, worth keeping except for the sake of money profit and material utility.

Before concluding this paper it may, perhaps, be permissible to add a few notes, from the side of religion, upon the remarkable parallelism and kinship between the faith of religion and the faith of science. In some respects, indeed, Christian faith—to take the most conspicuous instance in the Western world of religious faith—is different from the faith of science. The Christian religion is mainly a personal matter, and its faith is largely a faith in Persons; the Three Persons of the One God—Father, Son, and Holy Ghost, together with a personal apprehension of the attributes of these Divine Persons and of such of their past and future actions as have been made known on the authority of revelation.¹ Subjectively, indeed, all faith, whether religious or scientific, is personal; no other concept of faith is possible to man. There must be a believer, *i.e.* a being

¹ It is the personal objectivity of religious faith which inspires it with *feelings*, such as affection, devotion, reverence; unlike anything felt towards impersonal objects.

with a capacity for believing, before there can be a belief. But, objectively, the grand and fundamental difference between religious and scientific faith is personality. Both scientist and Christian understand invisible things by things visible. They have no other means of understanding them; an hypothesis must be interpreted by "the things which are made," else it cannot be interpreted at all. But Christian faith, unlike the feignings of science, personifies its hypothesis; and on the evidence of "the things which are made," believes not only in eternal power, but in the Personal God.

Apart, however, from the objective personalities of religious faith, there are several close similitudes between religious faith and the faith of science. Religious faith, in its truest, fullest sense, is not untested opinion or fluid imagination or mere traditional creed. Religious faith, like scientific faith, can be tested by experiment, and proved in particular instances, and made sure in the laboratory of individual experience. Of course it is necessary to fulfil the conditions of any experiment before the experiment will yield its promised results. There are multitudes of scientific experiments which, if conducted in unrayed darkness and fetid air, would not be likely to prove a great success. Experiments require both their proper atmosphere and their proper light. If you extract all the oxygen from a laboratory, that laboratory becomes unfit and useless for experiment. To make experiments in electricity there must be the presence of electricity. Similarly, you must first have faith before you can make experiments in faith. If you extract belief from the laboratory of prayer, you can make no experiments in prayer. But in religion, as in science, if you fulfil the conditions of the experiment—if you conduct it with proper light and air and heat—the experiment of trust in a Personal God will prove as unailing and sure as an experiment in any department of philoso-

phical science. The test of the truth of Christian belief, like the test of the truth of scientific hypothesis, lies in the witness of the individual instance to the certainty of the several hypotheses. By proper trial I can know as assuredly that God is as that gravity attracts.

Finally, as scientific discoveries come only to those who bend their minds that way; as Nature will not reveal herself to those who do not bow with the homage of patient, reverential labour before her shrine, so is it also with religious discovery, the discovery of God and His Christ. Upon them who are careless and incurious, as also upon them who, although deeply thinking, do not think in the Christian plane of thought, the inspiration, the flash, of the Gospel light will not burst. But let a man only bend his mind that way, let him work and toil to penetrate the secrets of the Gospel with an assiduity equal to that with which he labours in the workshops of Nature; and he will find that his discoveries in religion will not be less plenteous, though perhaps less communicable, than his discoveries in science. He will also find that the borderland between religion and science is not a barren ridge between hostile tribes, but a fruitful stream into which the waters of both territories flow, and by which both alike are mutually enriched. In the end religion will prove as necessary to the perfection of science as we have seen faith to be necessary to the enlargement and consummation of knowledge.

JOHN W. DIGGLE.