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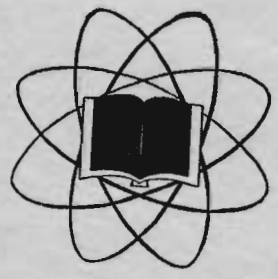

The fear of the Lord is the beginning of wisdom. Psalm 111:10

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The American Scientific Affiliation

(Incorporated)

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EXECUTIVE COUNCIL

The Journal Of The American Scientific Affiliation

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*"A Critique of Evolution"**

W. R. THOMPSON

When I was asked by the publishers of this new edition of *The Origin of Species* to write an introduction replacing the one prepared a quarter of a century ago by the distinguished Darwinian, Sir Arthur Keith, I felt extremely hesitant to accept the invitation. I admire, as all biologists must, the immense scientific labours of Charles Darwin and his lifelong, singlehearted devotion to his theory of evolution. I agree that although, as he himself readily admitted, he did not invent the doctrine of organic evolution, or even the idea of natural selection, his arguments, and especially the arguments in *The Origin of Species,* convinced the world that he had discovered the true explanation of biological diversity, and had shown how the intricate adaptations of living things develop by a simple, inevitable process which even the most simple minded and unlearned can understand. But I am not satisfied that Darwin proved his point or that his influence in scientific and public thinking has been beneficial.

I therefore felt obliged to explain to the editors of Everyman's Library, that my introduction would be very different from that of Sir Arthur Keith, and that I could not content myself with mere variations on the hymn to Darwin and Darwinism that introduces so many text-books on biology and evolution, and might well be expected to precede a reprinting of the *Origin.* They raised no objection, so my main difficulty was removed. I am of course well aware that my views will be regarded by many biologists as heretical and reactionary. However, I happen to believe that in science heresy is a virtue and reaction often a necessity, and that in no field of science are heresy and reaction more desirable than in evolutionary theory. I have written what I think should be written; but the responsibility of the editors of the library is not involved.

I have said that it was mainly *The Origin of Species* that converted the majority of men to the evolutionary doctrine. Sir Arthur Keith emphatically agreed. 'No book,' he said, 'has appeared to replace it; *The Origin of Species* is still the book which contains the most complete demonstration that the law of evolution is true.' But the more strongly we insist on this point, the more necessary it is to scrutinize the proofs given in the *Origin.* Of course, we may be induced to accept a statement that is true, by agreements that are fallacious or inadequate. Still, no one would seriously maintain that it is good to do the right thing for the wrong reasons. If arguments fail to resist analysis, assent should be withheld, and a wholesale conversion due to unsound argument must be regarded as deplorable.

For Sir Arthur Keith, Darwin as a writer may be classed among the 'small select group of great Englishmen which holds Shakespeare.' The literary critics, apparently, did not agree with him. Though he has often been regarded as an obscure writer, Darwin usually expresses himself clearly enough. He was not interested in philosophical considerations or in the exact definition of the terms he used. In the final chapter of the first edition of *Origin,* where he recapitulates his arguments, the word evolution is not even mentioned; yet the proposition he is defending can easily be defined. This is, that all the organisms that exist or have existed have developed from a few extremely simple forms or from one alone, by a process of descent with modification. The mechanism of these transformations though infinitely complex in its detailed working, is very simple in principle. For reasons not fully understood organisms tend to vary slightly in their various characteristics. These variations must be called random in the sense that they have no predestined relation to the well-being of the organism. Nevertheless since they occur continually in many directions, an individual in which a particular variation has occurred will have a slight advantage over its competitors in a particular environment. The advantage will be transmitted to its progeny in which, owing to varation, it will be manifested in different degrees, and thus there will occur through successive generations, a progressive adaptation to the environment from which the inadequately equipped competitors will disappear either through extinction or by adaptation to a different environment. We must, says Darwin, admit the truth of the following propositions: 'that gradations in the perfection of any organ or instinct, which we may consider, either do now exist or could have existed, each good of its kind —that all organs and instincts are, in ever so slight a degree, variable—and, lastly, that there is a struggle for existence leading to the preservation of each profitable deviation of structure or instinct.' These truths being admited, the theory of descent with modification through natural selection, must be accepted. This explanation has universal value. It enables us to understand that every mental power and capacity has been a gradual but necessary acquirement and thus the origin and history of man become scientifically comprehensible. And as the past has been, so will the future. We may look with some confidence, says Darwin, 'to a secure future of equally inappreciable length. And as na-

*This is the introduction to Charles Darwin's "Origin of Species" New York, E. P. Dutton & Co. Inc. 1956 and is published with the permission of Dr. Thompson, Everyman's Library, and E. P. Dutton & Co., Inc.

tural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.'

The view that natural selection, leading to the survival of the fittest, in populations of individuals of varying charateristics and competing among themselves, has produced in the course of geological time gradual transformations leading from a simple primitive organism to the highest forms of life, without the intervention of any directive agency or force, is thus the essence of the Darwinian position. Purposeless and undirected evolution, says J. S. Huxley, eventually produced, in man, a being capable of purpose and of directing evolutionary change. This, it appears to me, remains the view of the most representative modern Darwinians. It is true that Darwin himself admitted a Lamarckian element, the effects of use and disuse, and Sir Arthur Keith defended him against those who accused him of relying exclusively on natural selection. But this, in the modern view, would be a virtue of Darwin's theory since the inheritance of acquired characters is now generally denied by biologists.

We must now examine the arguments in the 'demonstration that the law of evolution is true.'

Darwin's first argument, to which he devoted a great deal of labour, is that there is great variation among the individuals of many species. This variation is particularly evident among domesticated animals and plants. From these undeniable facts Darwin drew several conclusions. One was that species are not strictly immutable as biologists commonly maintained. The difference between the various types of domesticated species is often much greater than that which exists between wild species, and even in these it is often extremely difficult to decide whether a particular form is a species or a variety. The great difference in the forms of domesticated species shows, on one hand, that variation can be stimulated by particular conditions and that the artificial selection made by breeders has produced forms with extremely distinctive characteristics. The differences between the various species of violets or between the species of the hymenopterous genus *Mesoleius,* for example, are clearly far less striking than the differences between a pekinese and an Irish setter, or between a snow apple and a russet. Darwin points out that under certain conditions abnormal individuals are produced, and he maintains that it is impossible to draw a line between such monstrosities and the individuals regarded as normal. These converging arguments indicate that what we call a species is just a transitional stage in a genealogical succession which cannot at any time be regarded as having a permanent definable essence or nature. There is therefore no intrinsic obstacle to unlimited evolution and the extrinsic conditions for it exist.

That natural selection directs the course of evolution Darwin could not prove by an appeal to facts. However, he felt certain that all organisms tend to increase in geometrical ratio, that each lives by a struggle for its requirements at some period in its life and that among individuals differing even to a slight degree, the fittest must survive and transmit their characteristics to their offspring and, since these will continue to vary, natural selection will progressively improve the adaptations and equipment of each species. 'What checks the natural tendency of each species to increase in number,' said Darwin, 'is most obscure . . . ' 'We know not exactly what the checks are even in one single instance.' He was able to show from factual examples that there is a great destruction of individuals in nature and to indicate some of the causes of this destruction; but he had little detailed evidence to offer concerning the action of natural selection.

Whether or not natural selection has produced the existing and past diversity of organic forms, this diversity exists, not only in space but in time. Such facts as the presence of different species of the same genus in different islands in the same area are consonant with the idea of descent with modification from a common ancestor as is the absence in isolated islands of organisms without active powers of migration and the presence of others such as bats and birds, taxonomically related to those of mainland areas.

Other supporting arguments were advanced by Darwin: the slow change and apparent progression of organic forms in the geological strata, the evidence of the existence in the past of a great variety of organisms now extinct; the similarity between the embryonic stages of organisms quite distinct in the adult condition; the existence of rudimentary organs; and the fact that a natural classification of organisms is possible, since this indicates real blood relationship and is therefore in a sense a mirror of the genealogical system by which they arose.

I have tried to include in a necessarily brief summary the most important points in Darwin's argument and have not designedly attempted to weaken the presentation. If Darwin convinced the world that species had originated through evolution by natural selection, it was, I think, on the basis of the arguments I have mentioned

But in a matter of this kind a great deal depends on the manner in which arguments are presented. Darwin considered that the doctrine of the origin of living forms by descent with modification, even if well founded, would be unsatisfactory unless the causes at work were correctly identified, so his theory of modification by natural selection was, for him, of absolutely major importance. Since he had at the time the *Origin* was published no body of experimental evidence to support his theory, he fell back on speculative arguments The argumentation used by evolutionists, said de Qua-

trefages, makes the discussion of their ideas extremely difficult. Personal convictions, simple possibilities, are presented as if they were proofs, or at least valid arguments in favor of the theory. As an example de Quatrefages cited Darwin's explanation of the manner in which the titmouse might become transformed into the nutcracker, by the accumulation of small changes in structure and instinct owing to the effect of natural selection; and then proceeded to show that it is just as easy to transform the nutcracker into the titmouse. The demonstration can be modified without difficulty to fit any conceivable case. It is without scientific value, since it cannot be verified; but since the imagination has free rein, it is easy to convey the impression that a concrete example of real transmutation has been given. This is the more appealing because of the extreme fundamental simplicity of the the Darwinian explanation. The reader may be completely ignorant of biological processes yet he feels that he really understands and in a sense dominates the machinery by which the marvellous variety of living forms has been produced.

This was certainly a major reason for the success of the *Origin*. Another is the elusive character of the Darwinian argument. Every characteristic of organisms is maintained in existence because it has survival value. But this value relates to the struggle for existence. Therefore we are not obliged to commit ourselves in regard to the meaning of difference between individuals or species since the possessor of a particular modification may be, in the race for life, moving up or falling behind. On the other hand, we can commit ourselves if we like, since it is impossible to disprove our statement. The plausibility of the argument eliminates the need for proof and its very nature gives it a kind of immunity to disproof. Darwin did not show in the *Origin* that species had originated by natural selection, he merely showed, on the basis of certain facts and assumptions, how this might have happened, and as he had convinced himself he was able to convince others.

But the facts and interpretations on which Darwin relied have now ceased to convince. The long-continued investigations on heredity and variation have undermined the Darwinian position. We now know that the variations determined by environmental changes—the individual differences regarded by Darwin as the material on which natural selection acts—are not hereditary. We can, by selection, sort out from a natural population a number of pure lines or genotypes, each possessing with respect to a given character its special curve of variability; but we cannot change this curve by selection within the genotype. For example, in a certain pure line of the house-fly, those with the longest wings may conceivably have an advantage—though I cannot see how this could be demonstrated. But we cannot, by choosing and mating these long-winger flies, produce a progressive increase in the proportion of long-winged flies, or a progressive increase in wing length.

It is true that some variations are hereditary. These are the so-called mutations which do not develop gradually but appear suddenly and remain as they appeared. The varieties of domesticated plants and animals are the result of mutations. But such forms must be eliminated in nature, which would other-wise present a spectacle entirely different from the reality. This is partly due to the fact that mutations are not adaptive. If we say that it is only by chance that they are useful, we are still speaking too leniently. In general, they are useless, detrimental, or lethal. Darwin himself did not think that the races of domesticated animals were capable of surviving in nature, but the modern Darwinians are obliged to explain evolution as the result of mutations. If we minimize or at least limit the survival value of characters in general, we can agree that certain distinctive morphological dispositions may well be the the result of mutations. But the neo-Darwinians hold firmly to the belief that every specific character has survival value. This to my mind puts them in a very awkward position.

To realize how unconvincing their position is, we have only to consider the fact of organic correlation. Strangely enough, though Darwin was evidently well acquainted with the work of Cuvier he pays practically no attention, in the *Origin*, to Cuvier's principle of adaptive correlation. For him correlation is merely a concurrence of characters like 'the relation between blue eyes and deafness in cats, and the tortoise-shell colour with the female sex, the feathered felt and skin between the outer toes of pigeons, and the presence of more or less down on the young birds when first hatched, with the future colour of their plumage; or, again, the relation between the hair and teeth in the naked Turkish dog.' Indeed Darwin's remarks suggest that he thinks of correlation as a material connection between malformations rather than as an adaptation. His modern disciples in general simply ignore the problem of correlation. However, to ignore it is easier than to solve it. As Emile Guyenot has said, mutations are powerless to explain the general adaptation which is the basis of organization. 'It is impossible to produce the world of life where the dominant note is functional organization, correlated variation and progression, from a series of random events.' The position therefore is that while the modern Darwinians have retained the essentials of Darwin's evolutionary machinery, to wit, natural selection, acting on random hereditary variations, their explanation, plausible in Darwin's day, is not plausible now.

It has been said that the substitution of particulate for blending inheritance removed what was a serious difficulty in Darwin's own position. The interference

with progressive evolution resulting from blending inheritance was certainly a weakness in the argument of the *Origin* but, as I have said, particulate inheritance has introduced other difficulties.

An important point in Darwin's doctrine, as set out in the *Origin,* was the conviction that evolution is a progressive process. We may look forward, he said, to a secure future of inappreciable length. 'And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.' The Victorians accepted this idea with enthusiasm. Here I need only to say that on this point Darwin was inconsistent since, in his view, natural selection acts not only by the survival of the fittest but also by the exterminiation of the less fit and may produce anatomical degradation as well as improvement.

That owing to the existence of different genotypes within a species and the somewhat different adaptive-characters of these genotypes, samples of a widespread population taken at different points may be reconizably different in various ways, or a population of this kind spreading from a centre (as in the case of an introduced insect) may develop local varieties sufficiently marked to be regarded as species by a taxonomist, may be freely acknowledged. Furthermore, when we consider the development of a complex organism from the structurally simple germ cell, we must recognize that in this field, at least, evolution, in the classical sense, is a fact accessible to direct observation. But it is a far cry from these facts to the speculations of the *Origin* and the Victorian concept of evolution.

It is hardly necessary to dwell at length on all the minor arguments advanced by Darwin. These consist essentially in a translation of certain facts in terms of evolutionary theory, or, in other words, on an historical basis. If an organism possesses a structure having no assignable function, but looking like a reduced specimen of a functional structure existing in some other form, it was regarded as a 'rudiment' whose existence is explicable only as a relic that has gradually degenerated in coming down from a remote ancestor, where it was well developed and functional.

It is clear that this supposition has no demonstrative value. It itself requires demonstration. Unless one adopts the Darwinian postulate that all characteristics have survival value, it is not necessary to assume that they have, or ever had, definite functions. Some so-called rudiments, such as the homologues of the mammary glands in man cannot, so far as any plausible evidence goes, have been inherited from an ancestor in which they were functional. Others, once believed to be useless, have definite functions. The existence in whales of transitory teeth and of small bones buried in the flesh, but corresponding to the pelvis, the femur, and the tibia, is commonly regarded as a proof of their descent from ancestors of the tetrapod type with functional teeth; but in the first place some anatomists consider that these structures have an impotant role in the developmental process; in the second place, we have no proof of a descent from ancestors in which these structures were more strongly developed; in the third place, it is clear that if they exist now, this is not primarily because they existed in the past, but because actual present causes now operate to produce them. What such cases like those of anatomical 'convergence' and general homology actually demonstrate is that there are large numbers of organisms, differing considerably in the details of structure but constructed on the same fundamental plan. However, this is no proof of descent from one original ancestor of this anatomical type. This itself requires proof. It may be said that unless we admit this, we must make the much more difficult supposition that many complex types originated independently. This, it will be remembered, was a point Darwin made against Lamarck. But I, for my part, do not see that I am obliged to express a view on such matters. Darwin himself considered that the idea of evolution is unsatisfactory unless its mechanism can be explained. I agree, but since no one has explained to my satisfaction how evolution could happen I do not feel impelled to say that it has happened. I prefer to say that on this matter our information is inadequate.

Darwin suggested in the *Origin* that embryological development provides evidence for evolution. He postulated that characteristics appear in the embryo at the stage in which they developed in the ancestor, so that new developments may be tacked on, so to speak, to a phase representing the ancestral development, since Darwin also held that the slight variations on which, in his view, evolution depends, 'generally appear at a not very early period of life.' This idea, elaborated by other workers, eventually became in the hands of Haeckel the 'great biogenetic law,' according to which the ontogeny repeats the phylogeny, or, as propagandists have put it, the developing animal 'climbs up its family tree.'

A natural law can only be established as an induction from facts. Haeckel was of course unable to do this. What he did was to arrange existing forms of animal life in a series proceeding from the simple to the complex, intercalating imaginary entities where discontinuity existed and then giving the embryonic phases names corresponding to the stages in his so-called evolutionary series. Cases in which this parallelism did not exist were dealt with by the simple expedient of saying that the embryological development had been falsified. When the 'convergence' of embryos was not entirely satisfactory, Haeckel altered the illustrations of them to fit his theory. The alterations were slight but significant. The 'biogenetic law' as a proof of evolution is valueless.

A more important argument in the opinion of Dar-

win himself was the possibility of classifying organisms. All true classification, he said is genealogical. Community of descent 'is the hidden bond which naturalists have been unconsciously seeking.' The arrangement of the groups within each class, 'in due subordination and relation to the other groups, must be strictly genealogical in order to be natural.' And again, 'the natural system is genealogical in its arrangement, like a pedigree; but the degrees of modification which the different groups have undergone have to be expressed by ranking them under so-called different genera, subfamilies, sections, orders, and classes.' What we call the natural system of classification is a proof of evolution since it can only be explained as a result of evolution.

The plausibility of this argument is obvious. Yet it is not so convincing as it may appear at first sight. On the Darwinian theory, evolution is essentially undirected, being the result of natural selection, acting on small fortuitous variations. The argument specifically implies that nothing is exempt from this evolutionary process. Therefore, the last thing we should expect on Darwinian principles is the persistence of a few common fundamental structural plans. Yet this is what we find. The animal world, for example, can be divided into some ten great groups or phyla, all of which are not morphologically as coherent and clear-cut as we might wish for convenience in classification, but nevertheless are stable and definable entities from the taxonomic standpoint. All identifiable animals that ever have existed can be placed in these groups. Generally speaking, the subordinate groups are equally well defined. We can tell at a glance to what Order or Family a particular insect belongs. As I have already noted there is often controversy and uncertainty about the definitions of genera, species, and varieties; but taking the taxonomic system as a whole, it appears as an orderly arrangement of clear-cut entities which are clear-cut because they are separated by gaps. These gaps Darwin explained by the hypothesis that the intermediates are constantly eliminated by natural selection. I do not think we can be expected to accept his unproved supposition as an argument for Darwinism. But in any case it has no bearing on the persistence throughout geological time, in spite of the fortuitous variation and natural selection, on the persistence of the fundamental anatomical plans exhibited by the great groups. Darwin insisted on several occasions that characteristics long inherited become stabilized and perhaps he considered that the persistence of morphological types can be explained in this way. But without introducing considerations quite foreign to his system, we cannot explain why the anatomical type of the Echinoderm or the Insect continued to be inherited.

Because all organisms we know are generated by other organisms, it is natural to interpret biological classification in terms of genealogy, But not all the thing that can be classified are connected by generation. The arrangement of the chemical elements and their compounds is a true classification and so is the arrangement of geometric forms; yet no genealogical considerations are involved. Looking at the matter from this angle, we can easily see that in actual fact the system of biological classification is simply based on the characteristics of organisms as they are here and now. The basis of these characteristics here and now is the physicochemical constitution. If we wish to erect a genealogical classification we cannot do so with a collection of abstractions drawn from our arrangement of existing organisms—we must discover through what forms the existing organisms have actually descended. If these historical facts cannot be ascertained, then it is useless to seek for substitutes, and from the fact that a classification is possible we certainly cannot infer that it is genealogical and is in any sense a proof of evolution.

Evolution, if it has occurred, can in a rather loose sense be called a historical process; and therefore to show that it has occurred historical evidence is required. History in the strict sense is dependent on human testimony. Since this is not available with respect to the development of the world of life we must be satisfied with something less satisfactory. The only evidence available is that provided by the fossils. It has been pointed out by both supporters and opponents of the evolutionary doctrine, that even if we can demonstrate the chronological succession of certain organisms, this is not proof of descent. This may seem like a quibble. If we put a pair of houseflies in a cage and let them breed, we do not doubt that the live flies we find there in a month's time are the descendants of the original pair. Similarly, if in an apparently undisturbed geological formation we find snail shells at an upper level very similar to those at a lower level, we may reasonably conclude that there is some genealogical connection between the two groups, though we cannot trace the descent from individual to individual as is required in a true family tree. Therefore, if we found in the geological strata a series of fossils showing a gradual transition from simple to complex forms, and could be sure that they correspond to a true time-sequence, then we should be inclined to feel that Darwinian evolution has occured, even though its mechanism remained unknown. This is certainly what Darwin would have liked to report but of course he was unable to do so. What the available data indicated was a remarkable absence of the many intermediate forms required by the theory; the absence of the primitive types that should have existed in the strata regarded as the most ancient; and the sudden appearance of the principle taxonomic groups. Against these difficulties he could only suggest that the geological record is imperfect, but that if it had been perfect it would have provided evidence for

his views. It is clear therefore that the palaeontological evidence at his disposal, since it had not led competent naturalists acquainted with it to a belief in evolution, could only justify a suspense of judgment. The condition of fossil material is, of course, unsatisfactory since soft tissues usually disappear, leaving only skeletal structures, frequently much distorted. The fossil insects of the group with which I am best acquainted cannot be accurately determined, even to genera. It is evident that many organisms now extinct existed in the past, but we can never know them as we know living forms. The chronological succession of the fossils is also open to doubt, for it appears, generally speaking, that the age of the rocks is not determined by their intrinsic characteristics but by the fossils they contain; while the succession of the fossils is determined by the succession of the strata. It was thought also that the fossils should appear in a certain order, corresponding roughly to the stages in embryological development. In fact the strata, and therefore the fossils they contain, do not always occur in the accepted order. In some areas of the world for example, the Cambrian strata, which are regarded as the oldest fossiliferous formations, rest on the Cretaceous which are regarded as relatively recent; in other, Cretaceous or Tertiary beds appear, instead of the Cambrian, on the granite. Sometimes the character of the deposits would lead to the belief that they were chronologically continuous since they can be separated only by the fossils they contain. Various hypotheses have been proposed to explain these departures from accepted theory, and though they are often the subject of controversy among geologists I do not suggest that the problems to which they relate are insoluble.

On the other hand, it does appear to me, in the first place, that Darwin in the *Origin* was not able to produce palaeontological evidence sufficient to prove his views but that the evidence he did produce was adverse to them; and I may note that the position is not notably different to-day. The modern Darwinian palaeontologists are obliged, just like their predecessors and like Darwin, to water down the facts with subsidiary hypotheses which, however plausible, are in the nature of things unverifiable.

It has been said that though we do not find in the geological deposits the intermediates required by Darwinian theory, some very striking intermediates have been found of which the classical oft-cited example is *Archaeopteryx*. To me, however, it appears that since the geological strata probably represent environmental conditions very different from those of the present, collections made in them may be regarded something like those made on the continent of Europe or in the tropics, with respect to the fauna and flora of the British Isles. As the range of our collections extends, so we invariably enrich our representation of various groups, and this necessarily and inevitably entails the appearance of intermediate between the forms in the collection from the restricted area in which we started. The recognition of this fact, with respect to the collections of organisms existing here and now, does not necessarily commit us to any particular view of the origin of species; and the same thing is true of the collection of fossil material.

The Origin of Species converted the majority of its readers to a belief in Darwinian evolution. We must now ask whether this was an unadulterated benefit to biology and to mankind. Sir Arthur Keith, as we have seen, had no doubts about this point. Some of the Darwinian propagandists were even more positive.

Writing in his Anthropogeny of the evolutionary controversy, Haeckel asserted, that in this intellectual battle, which excites all the thinking sections of humanity, and prepares for the future a truly humane society, we see on one side, under the splendid banner of science, the liberation of the mind, truth, reason, civilization, development, and progress. In the other camp are ranged, under the banner of the hierarchy, intellectual servitude, error, irrationality, barbarous ways of life, superstition, and decadence. Quite recently an evolutionary propagandist has said, that without the evolutionary doctrine, biology, except in certain restricted fields, becomes unintelligible.

I find myself unable to agree with these views. I do not contest the fact that the advent of the evolutionary idea, due mainly to the *Origin,* very greatly stimulated biological research. But it appears to me that owing precisely to the nature of the stimulus, a great deal of this work was directed into unprofitable channels or devoted to the pursuit of will-o'-the-wisps. I am not the only biologist of this opinion. Darwin's conviction that evolution is the result of natural selection, acting on small foruitous variations, says Guyenot, was to delay the progress of investigations on evolution by half a century. Really fruitful researches on heredity did not begin until the rediscovery in 1900 of the fundamental work of Mendel, published in 1865 and owing nothing to the work of Darwin. In his great work *Growth and Form,* D'Arcy Thompson remarked on the stultifying effect of Darwinian theory. 'So long and so far as "fortuitous variation" and the "survival of the fittest" remain engrained as fundamental and satisfactory hypotheses in the philosophy of biology, so long will these "satisfactory and specious causes" tend to stay "severe and diligent inquiry," "to the great arrest and prejudice of future discovery." ' Much time was wasted in the production of unverifiable family trees. For example, by plausible but unconvincing arguments zoologists have 'demonstrated' the descent of the Vertebrates from almost every group of the Invertebrates. During the thirty years from 1870 to 1900, there was an immense concentration of effort on embryology, inspired by the 'biogenetic law.' Here again

the main objective was the tracing of ancestries. The attempt of his to explain development in terms of actual physical causes was rejected with contempt by authors like Haeckel. 'We have better things to do in embryology,' said one of them, 'than to discuss tensions of germinal layers and similar questions, since all explanations must of necessity be of a phylogenetic nature.' Gradually it was realized that the objective was unattainable. Embryology then ceased to be fashionable. Taxonomists also followed the trend, constructing hypothetical ancestors for their groups and explaining the derivation of existing forms from these imaginary entities. I do not of course deny that a great amount of valuable information was gathered in these studies, but I think it could have been obtained more effectively on a purely objective basis. My impression is, also, that though it was unproductive from the Darwinian standpoint, this was not usually admitted. The deficiencies of the data were patched up with hypotheses, and the reader is left with the feeling that if the data do not support the theory they really ought to.

A long-enduring and regrettable effect of the success of the *Origin* was the addiction of biologists to unverifiable speculation. 'Explanations' of the origin of structures, instincts, and mental aptitudes of all kinds, in terms of Darwinian principles, marked with the Darwinian plausibility but hopelessly unverifiable, poured out from every research centre. The speculations on the origin and significance of the resemblances between animals, or between animals and their environment and of the striking colour patterns they often exhibit, constitute one of the best-known examples. In the article on 'Mimicry' in the 14th edition of the *Encyclopedia Britannica* we find a remarkable explanation of the form of tropical insect belonging to the group of the 'lantern-flies.' The head of this insect, which is not very large, resembles, in miniature, the head of an alligator, being prolonged into a snout at the base of which is a protuberance resembling an eye, while along the side are formations resembling minute teeth. Curious though the resemblance is, it is obviously a mere coincidence. The insect as a whole does not look anything like an alligator. However, for the Darwinian author of the article we have here an example of the development of protective resemblance by natural selection. The similarity of the head of the insect to the head of an alligator is a protection against monkeys. The monkey does not actually mistake the insect for an alligator but the sight of its head recalls to him the occasion on which an alligator almost seized him when he was drinking from a stream. Such is the effect of Darwinian fantasy on biological thinking.

The success of Darwinism was accompanied by a decline in scientific integrity. This is already evident in the reckless statements of Haeckel and in the shifting, devious, and histrionic argumentation of T. H. Huxley. A striking example, which has only recently come to light, is the alteration of the Piltdown skull so that it could be used as evidence for the descent of man from the apes; but even before this a similar instance of tinkering with evidence was finally revealed by the discoverer of Pithecanthropus, who admitted, many years after his sensational report, that he had found in the same deposits bones that are definitely human. Though these facts are now well known, a work published in 1943 still accepts the diagnosis of Pithecanthropus given by Dubois, as a creature with a femur of human form permitting an erect posture. Not long ago (1947), an exhibit in London, designed for public instruction, presented human development in such a way as to insinuate the truth of the 'biogenetic law'; and in the same exhibit were problematic reconstructions indicating the descent of man and including the Piltdown type.

As we know, there is a great divergence of opinion among biologists, not only about the causes of evolution but even about the actual process. This divergence exists because the evidence is unsatisfactory and does not permit any certain conclusion. It is therefore right and proper to draw the attention of the non-scientific public to the disagreements about evolution. But some recent remarks of evolutionists show that they think this unreasonable. This situation, where scientific men rally to the defence of a doctrine they are unable to define scientifically, much less demonstrate with scientific rigour, attempting to maintain its credit with the public by the suppression of criticism and the elimination of difficulties, is abnormal and undesirable in science.

It is difficult to assess the effect of the *Origin* on the public mentality. It must be considered in conjunction with Darwins' later work: *The Descent of Man* and the writings of the supporters of Darwin in several countries. However, Sir Arthur Keith said that Darwin himself had done more than anyone to lift 'the pall of superstition' from mankind and, in another place, that Darwinism is a 'basal doctrine in the rationalistic liturgy.' These remarks suggest that in his opinion the decline of belief in the supernatural, and probably the decline of Christinity, is largely due to the influence of Darwin. I think there is much to be said for this view. It is true that in the *Origin* Darwin speaks of life 'having been originally breathed into a few forms or into one'; and refers to a Creator. Furthermore, he objected to the spontaneous generations for which Lamarck argued. But I think this objection was merely to an idea that would have made his own theory less comprehensively explanatory.

Although the *Origin* contains no direct attack on the Christian concept of the universe, it is, on a number of crucial points, opposed to this concept. The biblical account of the creation of living things can be, and often

has been interpreted in a manner more or less compatible with the doctrine of evolution. Propagandists like T. H. Huxley, however, made every effort to minimize this possibility, and to prove that Christian orthodoxy implies a literal interpretation of Genesis which is irreconcilable with the evolutionary idea. Darwin himself though he once held some rather vaguely Christian views, abandoned them quite rapidly and soon ceased to believe in the Christian revelation.

The doctrine of evolution by natural selection as Darwin formulated, and as his followers still explain it, has a strong anti-religious flavour. This is due to the fact that the intricate adaptations and co-ordinations we see in living things, naturally evoking the idea of finality and design and, therefore, of an intelligent providence, are explained, with what seems to be a rigorous argument, as the result of chance. It may be said, and the most orthodox theologians indeed hold, that God controls and guides even the events due to chance; but this proposition the Darwinians emphatically reject, and it is clear that in the *Origin* evolution is presented as an essentially undirected process. For the majority of its readers, therefore, the *Origin* effectively dissipated the evidence of providential control. It might be said that this was their own fault. Nevertheles the failure of Darwin and his successors to attempt an equitable assessment of the religious issues at stake indicates a regrettable obtuseness and lack of responsibility. Furthermore, on the pure philosophical plane, the Darwinian doctrine of evolution involves some difficulties which Darwin and Huxley were unable to appreciate. Between the organism that simply lives, the organism that lives and feels, and the organism that lives, feels, and reasons, there are, in the opinion of respectable philosophers, abrupt transitions corresponding to an ascent in the scale of being, and they hold that the agencies of the material world cannot produce transitions of this kind. I shall not attempt to discuss this difficult question here. Nevertheless it is clear that the view just mentioned has been that of mankind in general. That plants, animals, and man can be distinguished because they are radically different is the common-sense conviction, or was, at least until the time of Darwin. Biologists still agree on the separation of plants and animals, but the idea that man and animals differ only in degree is now so general among them, that even psychologists no longer attempt to use words like 'reason' or 'intelligence' in an exact sense.

This general tendency to eliminate, by means of unverifiable speculations, the limits of the categories Nature presents to us, is the inheritance of biology from *The Origin of Species*. To establish the continuity required by theory, historical arguments are invoked, even though historical evidence is lacking. Thus are engendered those fragile towers of hypothesis based on hypothesis, where fact and fiction intermingle in an inextricable confusion. That these constructions correspond to a natural appetite, there can be no doubt. It is certain also that in the *Origin* Darwin established what may be called the classical method of satisfying this appetite. We are beginning to realize now that the method is unsound and the satisfaction illusory. But to understand our own thinking, to see what fallacies we must eradicate in order to establish general biology on a scientific basis, we can still return with profit to the source-book which is *The Origin of Species*.

*Toward An Evangelical Philosophy of Science --The Historical and Recent Background**

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The general title of our three-day group of discussions indicates that we are interested in the search for a unifying discipline or viewpoint which may bridge or fuse what Carl Henry[1] calls "the cleavage between science and religion. . .one of the defacing characteristics of our culture." This author ably states the case when he says, "Evangelical theology, if it is to make a major contribution to synthesis, must propound a Christian philosophy of science tracing the implications of the sovereignty of God for all branches of science." It is the purpose of this presentation to call attention to the fact that such attempts, conscious or subconscious, have been made by Christian thinkers of all ages, but that only recently has the probem been seriously appreciated and only recently have deliberate attempts been made to formulate such a philosophy.

It would seem reasonable at the outset of an historical survey to try to formulate into a few general statements what factors ought to be included in an evangelical philosophy of science. No claim is made that the following three statements are complete or wholly correct, but they are at least an attempt to set down some of the things which ought to be included, and they are offered as a basis for discussion.

An evangelical philosophy of science must have as its basic set of axioms the Biblical teachings concerning the past, present, and future relation of God to the universe, and particularly to man, and it must concern itself with an examination of the nature of these axioms. Without this *a priori* no philosophy deserves to be called evangelical. In any scientific philosophy the relationship of the concepts of man and nature is considered, and the concept of God may be touched upon, or more often of recent years, completely ruled out as being outside the legitimate realm of consideration. An evangelical philosophy of science must, of course, include and relate all three. Ramm[2] has clearly stated some of these axioms under the heading of The Biblical View of Nature: creationism, teleology, the providence of God, only the creator is to be worshipped, the equating of the regularity of nature with God's constancy and of natural laws with divine laws, nature is temporal and a realm of probation and judgment. To these must be added the concept of the fall of man and its possible effects on nature, the plan of redemption and its historical fulfillment in the person and work of Jesus Christ, and the implications for the believer of this Gospel as far as his purpose in life is concerned.

Together with an understanding and acceptance of these principles, there must be an awareness of their nature and of the manner in which they have been derived. As Mary Rose[3] has phrased it, "the epistemology of faith turns upon the importance of the role of God who in relation to the believer has become a teacher." These precepts are God-given and are accepted not passively, nor disinterestedly, nor critically in the ordinary sense, but they imply a passionate and complete involvement, which will color and interpret all other principles which may be related to them.

Secondly, an evangelical philosophy of science, it seems to me, must explore the fundamental axioms and operating conceptions of science, and incorporate those which have gained universal acceptance and which do not inherently oppose or negate the axioms stated above. The subscription of science to the notion that time and space are real and that quantifiable matter exists in time and space, while unprovable, appear to be such universally accepted axioms which can be included in an evangelical framework of thought. Of a similar nature are the concepts of consistency of the universe and, with minor limitations, the intelligibility of the universe to man. The scientific axiom of determinism requires more careful examination and perhaps more serious modification. If it includes a denial of all possibility of "the intervention of transcendent and supernatural influences,"[4] then this phase of the axiom will need to be rejected since the prior assumption would thereby be negated.

Among the operating conceptions of science, those of objectivity, caution, theory construction and utilization, parsimony, and reductionism (in the sense of ever more inclusive generalizations)[6] all appear to be capable of being incorporated into an evangelical thought system and to be useful and necessary to attain a carefully integrated world view. Sinclair[6] has earlier pointed out that the last two, parsimony and reductionism, are desirable ideals for theology. The concepts of amorality and skepticism are inherently in contradiction to the Biblical tenets and will need to be rejected except as applied to very limited areas.

Finally, an evangelical philosophy of science must

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apply these two sets of axioms and their corollaries, interrelate them, and develop them into a consistent pattern of thought and procedure which is frankly aware of the limitations of the second group, and which not only tests the conclusions derived from them against the first set of axioms and its derived corollaries, but also uses these conclusions to give the first axioms relevance to the physical environment and to the present culture.

For the attainment of the first part of this lengthy desideratum one might conceive of an application of the principle of reductionism on a grand scale. As Lachman describes the principle, its purpose is to "develop concise generalizations based on its data and to reduce continually the data to a minimum number of generalizations."[7] One might then conceive of the data of revelation as one principle and the data of empirical science as another. The generalization of a higher degree, of greatest inclusiveness, would be the successful and consistent amalgamation of the two. However, for the Christian there will be no general doubt as to which of the two sets of data will yield the most in the combination process. Even as the law of conservation of matter gracefully yielded to the more encompassing principle of the conservation of energy, so the generalizations drawn from empirical methods will also find their place among the principles which are God-given, once all of the evidence is in.

In the process of being fitted into this basic scheme, however, the empirical conclusions may well wear away encrustations which obscure the true framework of revealed axioms much as a bolt when inserted into a painted frame bites away the paint which may have leaked into the pre-threaded hole. The hole may even have been completely painted over, and this fact may originally well have confused the assembler as to the whole pattern of the machine. But if, at long last, one bolt has gone home, the presence of a second one, unsecured, may well suggest a search in the general area which leads to the discovery of the proper fitting of the parts.

This possible mutual gain and also the difficulties in attaining it are suggested by the following statement in a recent symposium of theology, psychology, and psychiatry:[8]

> "We simply take for granted the truth of revelation found in Scripture . . . ; we also take for granted the essential correctness of what is held, on experimental or clinical grounds, by students of physiology, psychology, and psychiatry. If these two belief systems are both true, we ask what possibilities are conceptually available for accommodating them to one another.
>
> "Many modern teachers believe that the message of Christ can be conveyed most efficiently by borrowing some of the methods and terminology of modern science. "To present the Christian faith in the terms of a particular cultural climate is both necessary and risky. It is necessary if the Gospel is to be understood, because the church must meet people where they are. . . It is risky, according to the history of the Christian Church, because the process of translating the Gospel into the terms of any particular culture is so delicate that most attempts have been partial or total failures."

If this be correct, we are in our quest walking a delicate line between calculated risks and the compelling necessity placed upon us by the Gospel. To what degree historically the church has kept this desired balance is the question which we wish to explore in the remaining time.

II

Among primitive peoples such science as they knew and such religion as they practiced were one. Whether capricious or unchangeable, whether personal or impersonal, the supernatural power which they considered responsible for the operation of the universe was the power or powers whom they worshipped, tried to appease, and called their gods.[9] The mistaking of random sequences of events for cause and effect led to the practice of magic and to the development of the prestige of the witch-doctor who in a sense assumed the place of a professional man in his culture. Thorndike[10] has demonstrated that magic and primitive science grew up side by side.

Whatever the errors and evils residing in this peculiar combination of primitive science and primitive religion, it had the desirable feature of a single belief and outlook on life. Now to what degree was a similar integration accomplished in the primitive New Testament Church? Raven[11] contends that the Old Testament view lacked an adequate doctrine of divine immanence, that "God's relationship to the world was represented as external and transcendental". . . that there was no "clear sign of an indwelling deity or any development of the idea of God's Wisdom as His agent and representative." His thesis is also that such an integrated view of the universe was but poorly developed by the early Christian fathers.

Clement of Alexandria, who taught clearly the all-penetrating power of God in creation and in a continuing providence, "does not develop a fuller exposition of the order of nature." If one equates critical judgment with the scientific method, he apparently did reject current fables of nature,[12] and thus might be adjudged as using one facet of the scientific method. Origen developed his thinking a little farther, considering the knowledge of God as integrating all phenomena. Often he offers scientific arguments for his views. He argues, for instance, against the Genesis account of creation and against Adam's having been a historical personage.[13] Here a definite tension is developed rather than that an integrated view is accomplished. Augustine, writing in the fifth century, already began to reflect the change of view which tended to reject the world of nature as being corrupt and something from which the Christian should withdraw, rather than something to study as a complementary revelation of God's creation.

This is partly reflected in his *Enchiridion* (III, IX)[14]

> "Nor should we be dismayed if Christians are ignorant about the properties and the number of the basic elements of nature, or about the motion, order and deviations of the stars, the map of the heavens . . . and about the myriad of other things which these "physicists" have come to understand, or think they have . . . For the Christian, it is enough to believe that the cause of all created things, whether in heaven or on earth, whether visible or invisible, is nothing other than the goodness of the Creator, who is the one and true God."

According to Raven,[15] this view can be seen most clearly in Augustine's *De Civitate Dei,* which eventually in Raven's words "reduced the meaning of Providence to the protection and guidance of the church."

What are the possible reasons for this meagre development of anything approaching a true, Biblical philosophy of nature by the early church fathers? The four which Raven offers no doubt all have some validity. They are:

1. The church was in a world which would be attracted by the miraculous element. Hence, it emphasized the supernatural rather than the natural.
2. The pagan world was so corrupt that a revulsion to nature was inevitable.
3. The persecutions tended to cause them to emphasize the eschatological rather than the temporal.
4. The tendency to allegorize and to count nature as being only symbolical.[16]

To these might be added the great influence of Neoplatonic dualistic thought, and the fact that Platonic-Aristotelian *scientia* stressed the immanence of God exclusively, rather than transcendence, and that this view was regarded as antithetic to the Judeo-Christian faith.[17] Whatever the reasons, it appears to be clear that in the early church the problem of relating Biblical truth to observed nature and developing a unified world picture was not considered an important one, and was never seriously attacked. Rather, there was a gradual tendency to proceed from an ignoring of nature to an abhorring of it and a complete withdrawal.

III

This attitude increased and gradually merged into the typical view of the Dark Ages and the medieval period. This has been explored so many times that a passing mention should suffice. Seeing through the eyes, first of Platonic and later of Aristotelian philosophy, the church claimed to possess a final and complete interpretation of the world. There was indeed a unified picture, but only because the possibility of conflict was neatly eliminated by the assumption that revealed truth was considered the final interpretation of natural phenomena. Experimentation and discovery were interpreted within this framework, and tended to restrict themselves to description and practical improvements, rather than to develop any explanation of the universe other than the traditional one.

IV

From the fresh viewpoint of Reformation theology one might expect that a fresh approach to the problem of the relationship of scientific investigation and evangelical belief might arise, but the general verdict of historians seem to bear a negative witness. Thus James Harvey Robinson[18] takes rather an extreme view. He says:

> "In any attempt to determine the relative importance of Protestant and Catholic countries in promoting modern progress it must not be forgotten that religion is naturally conservative, and that its avowed business has never been to forward scientific research or political reform. Luther and his contemporaries had not in any degree the modern idea of progress which first becomes conspicuous with Bacon and Descartes, but believed, on the contrary, that the strangling of reason was the most precious offering to God."

So also Raven,[19] who states that under Luther's influence "there was no room for science or natural philosophy." Very often cited as supporting this judgment is Luther's statement, taken from the Table Talk, that he adjudged Copernicus a fool because he was trying to turn astronomy upside down with his claim that the earth revolved rather than the sun. Bornkamm[20] calls attention to the fact that the statement was made before any publication by Copernicus, that Reinhold, an avowed Copernican disciple, taught side by side with Luther at Wittenberg, and that Luther also readily grasped the fact that the Copernican view merely assumed a new reference frame from which to interpret the movements within the solar system. This does not at all mean that Luther considered the new theory plausible. He was as much a product of his age as any man, as much so as the scientists of his day who also opposed Copernicus, but a judgment as severe as that made by Robinson does not seem warranted.

Bornkamm[21] makes quite a case for Luther's views on nature, supporting it with thorough documentation. In nature Luther heard God's voice, saw His grace and goodness. From nature he drew many illustrations and much imagery, not in the exaggerated manner of an earlier day, but with a deep gratitude and wonder at the power and wisdom of God as revealed in it. For the pseudosciences, astrology and alchemy, he had a great scorn, and in his criticism of them he defined true science as a discipline involving evidence from experience. Bornkamm judges that the new approach which Luther assumed involved two things—a respect for reality as revealed in both the major and the minor things in nature, and a "profound understanding of the infiniteness of the world. . . . .embedded in the boundless and all-pervading presence of God who is so distant and at the same time so near." It is Bornkamm's view that Melanchthon's influence caused the Lutheran Reformation to revert to a reconciliation of the Aristotelian system with the Biblical concept of the world. In his words:[22]

> "His (Luther's) rich bequest to posterity had been dissipated. And when the modern view of nature insistently

rapped at the church's and at theology's door for admittance, there was no one who ventured to reach for the treasure that lay at hand in Luther's views for a true approach to the modern concept."

That scientific advances did grow out of the work of men who embraced the Reformation theology is not so well known because the history of science in this era is most often traced through the medium of the physical sciences. It is Raven's[23] judgment that in these centuries, the sixteenth and seventeenth, "the scientific revoluiton owed more to the botanists and zoologists and to the doctors and explorers than to the astronomers" whose names always are prominent in the historical surveys. He calls attention to the contributions in the form of herbals made by three Lutherans—Otto Brunfels, Jerome Bock, and Leonhart Fuchs, and also to the often neglected work of Conrad Gesner who came from the circle of the Swiss reformers at Zurich.

However significant the contributions of Protestant scientists in the Reformation and early post-Reformation era may have been, the fact remains that little progress was made toward an evangelical philosophy of science. There were again explanatory reasons for this. Modern science had not truly been born. Galileo, who died in 1642, was really sowing the seeds by his insistence that people believe the evidence observed by their instrumentally extended senses. Furthermore, the great intellects of the Reformation were preoccupied with more important matters. There were churches to organize, schools to supervise, catechisms to write, sermons to preach, and the development of a philosophy of science would have been a luxury even if the need for such a discipline had been recognized, which definitely was not the case. But one fundamental principle of the Reformation, the right of every man to be free to interpret Scripture, indirectly contributed to this development by suggesting every man's right to a personal interpretation of all knowledge.

V

As one moves past the time immediately following the Reformation, one finds one's self in the middle of the scientific revolution, that movement which Butterfiield[24] judges the greatest landmark in history since the rise of Christianity. Though, like all historic movements, the roots of this movement can be traced from considerably earlier dates, it is nevertheless true that experimentation as an essential part of the scientific method, the development of many significant and necessary instruments, and, above all, the direction of attention to the whole method itself, are concentrated in the seventeenth century.[25] This was the century of Hooke and the other microscopists, of Robert Boyle, of the last days of Galileo, of William Harvey, and of the productive years of Isaac Newton. What views which might lead to a satisfactory synthesis of revealed truth and scientific conclusions do we find in this highly productive era?

On the surface it would seem that at last a satisfactory synthesis had been achieved in the minds of these prominent men, who were for the most part Englishmen. Westphal[26] remarks that one of the common bonds of the virtuosi, who later formed what was to become the Royal Society, was their Christianity, and that the atheist, Thomas Hobbes, neither applied for, nor was suggested for membership. Futhermore, their works are replete with statements which make it clear that they considered the world a testimony to the intelligence, grandeur, and glory of God. Whether it was Hooke describing a flea seen under the microscope as "beautiful", or Flamsteed dedicating an astronomical calculation to the praise and glory of God, or Boyle computing the volume of the earth, all agreed that every phenomenon bore witness to God's wisdom and omnipotence. The pursuit of natural philosophy, as they called it, was an essential religious duty, a spiritual exercise, a religious experience. "All truth is one, they were saying; natural philosophy does not and cannot contradict Christianity."[27]

Born and reared in a Christian society, these men had their outlook toward nature and science shaped by their Christian beliefs. Even their conviction of the rationality of nature came perhaps more from their Christian assumptions than from the results of their observations and experiments. Despite all of these assumptions and good intentions, these originally pious Christian natural philosophers were inevitably moving farther and farther from the faith of the fathers, and its basic assumptions. While miracles in Biblical times were not denied, it was tacitly assumed that they ceased with the end of the apostolic era. The protestant rebellion to the Roman Church's emphasis on modern miracles and superstitions was no doubt also related to this view. In Wesphal's judgment, "the Calvinist God in His remote majesty resembles the watchmaker God of the mechanical universe, suggesting that the Calvinist tenor of English theology helped to make the mechanical hypothesis congenial to English scientists."[28] Eventually, the mechanical idea of nature which emerged contradicted miracles and the reality of divine providence. In other words, as their Christian background and belief had partly shaped their scientific philosophy, so, without their realizing it, their scientific procedures were shaping their Christianity, subtly changing it into a completely rational religion. Apparently, they were for the most part unaware of the occurrence of this change. They refused to believe that mechanism would challenge Christianity, because they assumed that the machine had to have a designer.

One can trace this gradual relegation of God to a more remote and less active role in the daily operation of the universe and the affairs of men through the statements of the less important figures to the final synthesis of Newton in his laws of universal gravitation,

and the much greater concessions in orthodox Christian doctrine to which he considered himself forced.[29]

While we may not agree with the very final conclusion reached by Westphal,[30] his description of what had happened in the seventeenth century attempt to harmonize science and religion seems otherwise quite accurate:

> "That picture of Newton in his old age writing and revising his statement on religion is the symbol of the insecurity that goaded the virtuosi as they sought a foundation for certainty. But certainty there was not to be. Following the birth of modern science the age of unshaken faith was lost to western man."

If one looks for the reason for this loss of certainty, it would seem to lie in the fact that these men had not carefully examined the basic philosophic grounds from which they were proceeding. There had been the quiet assumption that whatever they found would have to glorify God, but mainly overlooked was the fact that often these findings would result in extended implications, and that once committed to accept unquestioningly the results of the scientific method, a man was really committed to a criterion of truth which implied doubt as to the authority of faith and revealed truth. Had these men examined the philosophy of the method with as careful a scrutiny as they did the objects of the method, perhaps some of them would not have gone as far afield as they did.

VI

But these basic examinations were not made, and as science moved through the eighteenth and nineteenth centuries, it not only continued to go farther afield, but actually took over the entire field. Some of the results of the reformation, nationalism, the rationalizing tendency within the church itself, all tended to weaken the influence and effectiveness of the church on the thinking of men, and science aggressively took over more and more of the role which heretofore the church had played. "Scientists were no longer pleading for a right to state the truth as it was gathered from observation; they were asserting a new interpretation and picture of the world."[31]

In a way, this culminated in the great evolutionary controversy of the last century. This illustrated beyond a question the fact that religion and science were separated on the matter of a basic interpretation of life. The loss of the field is put into words thus by Carl Henry, "Religious life no longer supplies the strategic center of our cultural pattern. In fact, today the life of religion is not regarded as an indispensable element of cultural completeness and integration. The achievements of religious faith, consequently, are dismissed as irrelevant by scientifically enlightened men."[32] The steady movement toward this view continued throughout these centuries and into our own. It resulted in the publication of the works of White[33] and Draper[34] which pictured science and theology as being inevitable and unreconcilable opponents, giving the impression that this had ever been so and that any synthesis was not only improbable but inconceivable. It appeared that the two disciplines were without means or hope of communicating with one another. For a time this appears not to have been too disturbing to some people until the problem was made real for them by the invasion of the new philosophy and methodology into the realm of psychology and the social sciences. Then the issues had been made reasonably clear to all thinking individuals. Raven[35] summarizes the situation in these words: "By the first decade of the present century the frontier between science and religion had become almost an iron curtain: it was hard for an honest and intelligent youngster to keep a footing in both worlds."

This fundamental difference in viewpoint led to the clear cleavage, as Henry calls it, and for a long time it was more or less tacitly assumed in evangelical circles that this was inevitable. The rationalistic and eventually modernistic approach which developed among the Christian thinkers did not help matters any. It gave the appearance that science had indeed clearly taken over the entire field and that Christianity for intelligent people could continue to exist only if it adopted scientific principles *en masse,* thereby giving up almost the entire body of doctrine which were uniquely Christian. Among those who still felt that there was some room for faith, this was relegated to the rapidly decreasing minor area where science did not as yet definitely claim knowledge, but the feeling was strong that, given a few years, these stubborn pockets of ignorance would soon be mopped up, the occupation army could be disbanded, and a peaceful and truly progressive peace-time reign of the savior science would follow.

Evangelicals were perhaps partly to blame for this feeling of complete hopelessness as far as any reasonable communication might be concerned. Disillusioned by the modernistic defection, they made no real attempt to interpret traditional doctrines in the light of new scientific knowledge. Denouncements enough there were, and these sometimes were too general. One often got the impression in those days that scientific research itself was an evil thing, and that all who engaged in it were either hopelessly deluded or deliberately searching for a more rapid means to discredit Christian belief. Meanwhile Christian people were living longer, being cured of heretofore incurable diseases, and in general enjoying far reaching benefits which made them seriously wonder how all of these denouncements could possibly be true.

VII

Actually, the events which led to the present situation where in the words of Mascall,[36] "It is possible for theologians and scientists to engage in intelligent, good-humoured, and fruitful conversation," were taking place within the practically undisputed realm of pure

science itself. Einstein's presentation of his first Theory of Relativity, Planck's offering of the quantum theory, Heisenberg's uncertainty principle and other mathematical considerations challenged one of the sacrosanct assumptions and conclusions of physical science—the determinate nature of the cause and effect relationship, and the assumption that when one had an exact and full knowledge of all the givens, he would be able to predict the outcome of any interaction.[37]

Applied science and technology were also unwittingly contributing to the growing area of doubt in the minds of scientists that they alone held the methodological key to all knowledge. With the successful application of nuclear energy to the World War II problem came the crawling fear that all was not right. More insistent in scientific circles became the clamor that scientifically derived ethical principles did not seem to be adequate, that technology perhaps ought to be made to mark time until moral principles might catch up, so to speak. The atmosphere had changed rather completely and it became almost respectable for scientists to welcome suggestions and conversations with theologians, not in any tolerating manner, but with the sincere hope at least that they might make a contribution. To quote Raven again, "With the change in the scientific outlook from an almost arrogant confidence to an almost despairing hesitation about the possibility of reaching real knowledge there has come an opportunity for reopening the quest and a good prospect that the problems will no longer prove unanswerable."[38]

As indicated earlier, evangelical thinkers have not been idle in this improved atmosphere. From sources available it appears that as never before the true nature and source of misunderstandings have been grasped, and there is a humble determination to get to the very bottom of the matter if that is at all possible. Such titles as "Science and Religion, Which Way Rapprochement?",[39] "The Difficulties Which the Scientist Experiences in Accepting Theological Statements",[40] "Biological Development and the Christian Doctrine of Man"[41] display a willingness to communicate which had not existed for centuries before.

This willingness to communicate has led Christian thinkers to devote deserved attention to fundamental aspects of the problem and to basic principles rather than to become fruitlessly involved in trying to deny specific conclusions of scientific disciplines and to build up arguments against them. This approach is also shared by Christian men of science who are concerned with the accomplishment of a satisfactory synthesis. Illustrative of this is a part of Harold Schillings's conclusion in *Concerning the Nature of Science and Religion, A Study of Presuppositions:*

> Science and religion are fundamentally much more alike than is commonly supposed. Neither is essentially a logical structure deriving like a geometric system from underlying assumptions by syllogistic processes, though both do require rational systems of thought for their complete development and expression. Neither demands as a first step assent to prescribed formal assumptions. Of course, both do have presuppositions, and their attitudes toward them are essentially alike. In kind, these presuppositions are surprisingly similar.[42]

This stressing of the similarities between science and religion is an oft repeated feature of recent writings. We find Hesse stressing the same point. She points out that science originated as a Christian protest against Greek notions about the world, that the two disciplines have in common an interest in the natural world, a conviction that there is an inherent rationality in nature and a respect for the facts of nature.[43] Owen also points out the Christian origin of science, the fact that Christianity with its emphasis on life in this world offers an outlook which can hope to effect a reconciliation, and, finally, that there is a relationship to Christian doctrines in what he calls the four basic theses of the scientific tradition—empiricism, materialism, determinism, and optimism.[44]

Owen holds that the empirical approach is in essence a fulfillment of the biblical command in Genesis 1,26 to have dominion over all the earth, and that this function of modern science must be fully recognized as such by Christians who must also insist that there are other even more valid avenues to ultimate truth.[45] Perhaps relevant here is the following statement found in the symposium on religion and psychology cited earlier:

> "The 'scientific attitude' and the 'religious attitude' cannot coexist with respect to the same subject matter . . . the Christian faith amounts in its cognitive aspect to an *overbelief* (i.e. 'beyond' what science can show) rather than a *contradiction* (i.e. 'against' what science shows)."[46]

In relating materialism to the Christian faith, Owen quotes the statement of Temple, that Christianity is "the most vowedly materialist of all the great religions." In other words, the Christian doctrines of creation, the incarnation, the sacrament, and the resurrection involve a special relationship to the material which insists on its reality and importance in the divine scheme, but at the same time also insists that this is not the only nor the most important phase of reality.[47]

Determinism, Owen holds, is actually one aspect of the Biblical doctrine of sin, namely that man is not free but in bondage to sin, to a self-centeredness which pervades every aspect of his being and thinking, and which could be and was removed only by Christ's sacrifice of self. He also shows the connection with the concept of optimism in the Christian belief in the divine purposefulness of historical events eventually leading to a fulfillment of the creative and redemptive acts in the establishment of the eternal kingdom of God.[48]

Whether we agree on all of these claimed points of similarity and possible congruence or not, I think that we certainly would agree that this kind of talk and thought was and would have been impossible a generation or two ago, and illustrated is the point that an al-

together different climate prevails. This by no means implies that there are no real difficulties. Far from it. But the true nature of the difficulties is being carefully and dispassionately scrutinized and a common ground is being sought if one in truth exists.

There are, of course, dangers and hindrances. Coulson, for instance warns of the dangers in the arguments which claim that there is rational or scientific evidence for the existence of God inherent in Heisenberg's uncertainty principle or in the findings or parapsychology. He summarizes his views very bluntly in this way, "If we would find God in science, we must begin again." The danger, as he points out, is that the search is really for a 'God of the Gaps', who on the same ground will be ruled out of the picture if and when the scientific gaps in knowledge are closed.[49] Pertinent here perhaps is the comment of Weaver that "faith must not be thought of as something that bridges the gap between the end of evidence and the unknown."[50] It would seem that recent attempts to investigate by controlled experiments the efficacy of prayer in its effect on seedling growth are not destined to contribute much to the general problem.[51]

One of the serious attempts to bring scientific and theological thinking out of a state of tension is found in the concept of complementarity, in the sense that science and religion are "both deeply rooted in life, that each has something to offer that is unique and indispensable, that each at its best enriches the other, and that therefore life and truth would be incomplete and unsatisfying without the contributions of both."[52] This is the view of Schilling, which is in turn criticized by Henry C. Torrey[53] who insists that the Christian religion may not be placed in a complementary position,* but demands for it a transcending and synthesizing function in the search for truth. In his words, "Science is possible because the world of nature can be partially transcended and objectified. Religion is possible because of the Grace of God who cannot be transcended and objectified, even partially." That this criticism is well taken may be illustrated by the plea of a much more liberal commentator on Schilling's paper in the same issue of *The Christian Scholar,* who suggests as an extension of Schilling's views that the word "revelation" be dropped entirely or to "so define it as to permit the attitude and methodology of science to provide the approach to the propositions once considered as 'revealed'."[54] The danger appears to lie in yielding too much in striving to reach a common ground. Were one to accept in its entirety the concept of complementarity, one would be hard put to give a consistent, Biblical interpretation of Jesus' simple, but blunt words "I am the Way, the Truth, and the Life." (John 14, 6) He does not say, "I am part of the truth which is to be complemented by the scientific method."

Dangerous as these attempts at reaching agreement may be, they certainly have much to commend them in preference to the solution of compartmentalism, which Long[55] describes in this manner: "The same individual may talk of science and of religion—even in the same breath—and not face the issues of their relationship to each other or of the historical conflicts that have occurred between them." Long remarks that orthodox Protestantism is prone to compartmentalization of this kind because it finds in Scripture a full and complete system of truth, and he suggests as an alternate to compartmentalism a dialectical resolution between Biblical statement and scientific fact by adopting a revised concept of Biblical authority, one that is valid in the spiritual but not the verbal realm. This would not seem to be a solution acceptable within the framework of evangelical belief, but it is at least an attempt to avoid the false solution of glossing over problems or acting as if they did not exist. It is clear that there are still unsolved problems, despite the progress that has been made.

In "Some Thoughts on a Christian Philosophy of Science", T. H. Leith[56] last year remarked "Here to my mind, lies the heart of the problem of a Christian philosophy of science. Supposing I ask not just that one get some inner satisfaction from doing what he thinks is the will of God in pursuing a scientific career, but that he makes sense when he says that he sees the design of God in nature. . . . .Does he really see God as good, rational, and powerful in the human sense? Does nature have implicit in its glories the hand of God for all to see, and can they see when it is pointed out to them?" Leith's final answer to his own question is that the Christian because of his unique experience has the advantage over the non-Christian and hence sees what to the other is invisible. However, even to the Christian there are problems. One that is still plaguing for a completely satisfactory answer is the problem of fitting into the Christian doctrine of God's care and providence the observed struggle and sufferings of organisms in nature. Nature "red in tooth and claw" presents a problem to the idea of an immanent and active God. Raven[57] attempts a half-answer by explaining that just as an adolescent must be permitted to make his own mistakes in order to attain maturity, so in order to develop man, the evolving species must submit to a type of self-sacrifice. He tries to clinch the point with the dramatic statement that Jesus Christ Himself 'chose the Cross'. This again is a far cry from an evangelic Biblical answer to a puzzling question, but it emphasizes that theological knowledge also is far from complete. We simply do not know the full meaning of the second half of Romans 8. Perhaps here lies the unfound answer.

Another point which has been realized by recent Christian thinkers concerned with relating Christianity and science is that in the past in Christian theology

*In this criticism he is joined by Arnold S. Nash who also objects to religion, science, and art being considered at the same level. (p. 404 of same issue of **The Christian Scholar**).

there has been a tendency to consider God and the universe in terms of the Maker and his work or of the king and his realm, a concept which tended to picture God as essentially external to the world. There has been the tentative observation that were the doctrine of God's immanence made more clear, and were a greater emphasis placed upon the doctrine of the Holy Spirit and the creative activity of the Son, as stated in the Fourth Gospel, Christians might find the interpretation of nature a simpler matter.[58]

VIII

Thus far we have come, and looking back, one must admit that the travelling has been arduous while the distance traversed is small compared to the journey still before us. Christian thinking, preoccupied in its earliest years with thoughts of the second coming and the evils of a pagan world, failed to develop a systematic doctrine of nature, and yielded to the pressures to identify divine providence with the church, and to withdraw from the world. Then, for centuries shackled by earlier Greek and Aristotelian concepts, it closed its eyes, thinking the problem solved. When modern science first began to appear, it at first opposed it for the wrong reasons without a realization of the real issues involved. Distracted by the internal problems of the Reformation, it, for the most part, brushed aside the slowly growing tensions, and was unaware of their real significance throughout most of the critical seventeenth and eighteenth centuries. Finally aroused, in the next two centuries it lost almost all the battles because they were fought on the wrong end of the issues. After the beginning of the twentieth century, when scientific philosophy had become established in its own right, the inherent weaknesses and limitations began to emerge, Christians began to deal with the real problem. Some progress has been made. The atmosphere is one which invites conversations. False starts have been identified. While Hesse admits that "there is no satisfying synthesis of science and Christianity this side of the Kingdom of God",[59] we need to keep at the task of striving toward an evangelical philosophy of science.

BIBLIOGRAPHIC REFERENCES

1. Henry, Carl F. (ed), *Contemporary Evangelical Thought,* Great Neck, Channel Press, 1957, pp. 247 & 269.
2. Ramm, Bernard, *The Christian View of Science and Scripture,* Grand Rapids, Eerdmans, 1954, pp. 80-96.
3. Rose, Mary Carman, "Fideistic and Scientific Methods", *The Christian Scholar,* Vol. XLI, Number 3, September, 1958, pp. 367-374.
4. Lachman, Sheldon J., *The Foundations of Science,* Detroit, The Hamilton Press, 1956, p. 37.
5. *Ibidem,* pp. 58-59.
6. Sinclair, John S., "The Scientific Method and Faith", *Journal of the American Scientific Affiliation,* Vol. 9, No. 4, December, 1957, pp. 12-13.
7. Lachman, Sheldon J., *Op. cit.,* pp. 58-59.
8. *What Then, Is Man?,* Graduate Study Number III, A Symposium of Theology, Psychology, and Psychiatry, St. Louis, Concordia, 1958, pp. 6, 13.
9. Long, Edward Leroy, Jr., *Science and Christian Faith,* New York, Association Press (Haddam House), 1950, pp. 15-16.
10. Thorndike, Lynn, *History of Magic and Experimental Science,* London, Hutchinson, 1953, Volume I, pp. 1-32.
11. Raven, Charles E., *Natural Religion and Christian Theology* (First Series: Science and Religion), London, Cambridge at the University Press, 1953, p. 26.
12. *Ibidem,* pp. 44-45.
13. *Origen Against Celsus,* Book IV, Chap. XL, page 516; *Origen De Principiis,* Book IV, Chap. I, Par. 16, page 365: (Both in *The Ante-Nicene Fathers,* Volume IV, Authorized Edition, Buffalo, The Christian Literature Publishing Co., 1885).
14. Outler, Albert C. (ed), *Augustine: Confessions and Enchiridion,* Philadelphia, Westminster Press, 1955, pp. 341-342.
15. Raven, Charles E., *Op. cit.,* pp. 51-52.
16. *Ibidem,* pp. 48-49.
17. *Ibidem,* p. 26.
18. *The Encyclopaedia Britannica,* Eleventh Edition, Cambridge at the University Press, 1911, Volume XXIII, "The Reformation", p. 22.
19. Raven, Charles E., *Op. cit.,* p. 84.
20. Bornkamm, Heinrich, *Luther's World of Thought,* translated by Martin H. Bertram, Saint Louis, Concordia, 1958, p. 178.
21. *Ibidem,* pp. 176-194.
22. *Ibidem,* p. 194.
23. Raven, Charles E., *Op. cit.,* pp. 80-98.
24. Butterfield, H., *The Origins of Modern Science 1300-1800,* London, G. Bell and Sons, Ltd., 1957, p. 190.
25. *Ibidem,* pp. 91-97.
26. Westphal, Richard S., *Science and Religion in Seventeenth-Century England,* New Haven, Yale U. Press, 1958, p. 20.
27. *Ibidem,* p. 48.
28. *Ibidem,* p. 5.
29. Stace, W. T., *Religion and the Modern Mind,* New York, Lippincott, 1952, pp. 86-87.
30. Westphal, Richard S., *Op. cit.,* pp. 219-220.
31. Long, *Op. cit.,* p. 25.
32. Henry, *Op. cit.,* p. 248.
33. White, Andrew D., *A History of the Warfare of Science with Theology in Christendom* (Two Volumes), New York, D. Appleton and Co., 1910.
34. Draper, John William, *History of the Conflict Between Religion and Science,* Original text edited and abridged by Charles T. Sprading, New York, Vanguard Press, 1926.
35. Raven, Charles S., *Op. cit.,* p. 10.
36. Mascall, E. L., *Christian Theology and Natural Science,* New York, Ronald Press, 1956, p. XXI.
37. Raven, Charles E., *Op. cit.,* pp. 189-192.
38. *Ibidem,* p. 15.
39. Garhart, John D., *The Christian Scholar,* Vol. XLI, Number 2, June, 1958, pp. 163-166.
40. Alexander, Peter, *The Christian Scholar,* Vol. XXXVIII, Number 3, September, 1955, pp. 206-218.
41. Joranson, Philip N., *The Christian Scholar,* Vol. XXXVIII, Number 4, December, 1954, pp. 523-530.
42. Schilling, Harold K., *Concerning the Nature of Science and Religion: A Study on Presuppositions,* published by the School of Religion at the State University of Iowa, 1958.
43. Hesse, Mary B., *Science and the Human Imagination,* New York, Philosophical Library, 1955, p. 162.
44. Owen, D. R. G., *Scientism, Man, and Religion,* Philadelphia, Westminster Press, 1952, pp. 186-187.
45. *Ibidem.*
46. *What Then Is Man?,* cf. Reference 8 above, p. 298.
47. Owen, D. R. G., *Op. cit.,* p. 189.
48. *Ibidem,* pp. 189-190.
49. Coulson, C. A., *Science and Christian Belief,* Chapel Hill, University of North Carolina Press, 1955, pp. 22-28.
50. Weaver, Henry Jr., "A Christian Philosophy of Science", *Journal of the American Scientific Affiliation,* Vol. 6, No. 2, June, 1954, pp. 4-7.
51. "The Power of the Brief Burst". *Time,* Vol. LXIII, No. 15, April 13, 1959, p. 95.

52. Schilling, Harold K., "On Relating Science and Religion", *The Christian Scholar,* Vol. XLI, Number 3, September, 1958, p. 376.
53. *The Christian Scholar,* as in reference 52, pp. 398-401.
54. *Ibidem,* p. 403.
55. Long, Edward L., *Religious Beliefs of American Scientists,* Philadelphia, Westminster Press, 1952, pp. 113-122.
56. *Journal of the American Scientific Affiliation,* Vol. 10, No. 2, June, 1958, p. 16.
57. Raven, Charles E., *Science and the Christian Man,* London, SCM Press, 1952, pp. 37-41.
58. Raven, Charles E., cf. reference 11, pp. 19-21.
59. Hesse, Mary B., *Op. cit.,* p. 162.

*The New Challenge To Christian Scholarship**

ROBERT F. DeHAAN

Without doubt Christianity has been on the defensive for the last century or so. Within the life-time of many of us it has disintegrated—a child's castle at the water's edge, gradually being washed away by the waves of science and humanism until nothing more than a little nub of sand remains. Francis Bacon, to be sure, attempted long ago to prohibit science from entering the holy of holies of man's soul, where man meets his God. But as the philosopher Max Otto[9] points out, the prohibition was just a temporary treaty, as it were, protecting the citadel of the human spirit from attack only as long as the army was busily engaged elsewhere. The rights of the spirit were to be respected only as long as they did not stand in the way of science. When they did, the fortress of theology would be taken, the mysterious holy of holies blown to bits, and man's "spirit" led off among the other prisoners of science.

Let us accept for the moment the validity of this description of the state of affairs as regards Christianity, and inquire how it came to pass. In order to understand the situation we need to look at the basic dimensions of Western Civilization. Scholars have noted that Western Civilization draws its inspiration from two ancient sources: the Greco-Roman and the Hebrew-Christian cultures. These two cultures form the cables, as it were, from which our modern culture is suspended, much as the span of a bridge is suspended from its cables. Modern thinking is intertwined with strands that spring from these ancient cultures and can eventually be traced back to Rome and Athens on the one hand or to Jerusalem and Nazareth on the other.

Each of these two cultures has a genius of its own. The Book of Genesis gives a key to the interpretation of their significance. There we read that God created in man the instinct, urge, or call it what you will, to explore, understand, and conquer his universe.[6] This urge was clearly expressed by the Greeks and the Romans. Their tradition is embodied in the scientific enterprise of our day.

Genesis also gives the basis for an interpretation of the significance of the Hebrew-Christian culture. There we read the account of how God pronounced a blessing on the seed of the woman, Eve, from whom should come the Savior of mankind.[7] This blessing in the course of history came in the person of Jesus of Nazareth, who is the dynamic source of power of the Hebrew-Christian tradition.

Western Culture has not often been successful in integrating the lines of thought that stem from these two cultures. Only in rare individuals such as St. Augustine and St. Thomas Acquinas has an approach to the synthesis of the Greco-Roman and the Hebrew-Christian traditions of our culture been achieved. There appears to be a deep-seated incompatibility between the two modes of thought that makes one of them continually in the process of gaining or holding ascendancy over the other. Thus in the Dark Ages the Greco-Roman tradition was eclipsed to the point where the Western mind no longer knew of its existence. During the Renaissance, however, the Greco-Roman tradition was revived and Western man began to respond to it with sympathy and with spontaneous understanding, as Dr. William Pollard describes it.[11]

Dr. Pollard goes on to liken the present era to the Dark Ages because one of the basic sources of our culture has been eclipsed. Ours is not a Dark Age, to be sure. Some might even call it brilliant. But for all its brilliance it is a pointless age. Or as Riesman,[13] May,[8] Cassirer,[3] and other critics described it is an empty, rootless era. The ethical neutrality of modern science has encompassed our culture and removed the purposes that the Hebrew-Christian culture so manifestly supplied.

Yet the continual interaction and even conflict between these two powerful forces in our culture has been the strength of Western Civilization, I believe. They are both essential to our society. And neither one can be eclipsed indefinitely by the other because both of them represent the working out of man's most fundamental needs—to understand and have dominion over nature, and to have fellowship with his Creator.

Let us narrow down this discussion of the Greco-Roman tradition to the contribution of two men of

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science who stand so clearly in its light and whose work has been so devastating to the fortress of the Hebrew-Christian tradition. I refer to Charles Darwin and Sigmund Freud. In the estimation of Emil Brunner[2] these two men along with Marx and Nietzsche have most profoundly influenced modern Western thought.

One hundred years ago, Darwin published the book, *The Origin of Species*.[4] In the introduction to the Mentor Edition of the book, Sir Julian Huxley outlined the history and present status of the theory of evolution. He sums up the matter as follows: "Today, a century after the publication of *The Origin of Species* Darwin's great discovery, the universal principle of natural selection, is firmly and finally established as the sole agency of major evolutionary change."

One suspects, from remarks such as these, that Darwinism is something more than just a scientific theory that has stimulated untold amounts of research and therefore enhanced man's knowledge of himself and his universe. One finds in a person like Huxley a certain exultation and even glee to have found apparently unassailable scientific proof that man's origin and destiny can be accounted for without reference to the Hebrew-Christian concepts of the Creation of the world, man's dependence on God and the culmination of history in the second coming of Christ. In Darwinian evolution man found a seemingly rational basis for the belief that he is independent of God, that he can know good and evil, that he can live forever in the race, in short, that he himself can be God. This egocentric craving in the heart of man, which constitutes his basic rebellion against God, received powerful support in the theory of evolution. People responded to it with sympathy and spontaneous understanding. Primarily, it is for this reason I believe, that Darwinian evolution took such a strong hold and has such profound effects on Western thought, especially in the United States.

A second wave that engulfed the already crumbling fortress of the Hebrew-Christian tradition was unleashed by Sigmund Freud. In his book, *The Future of An Illusion*,[5] Freud asserted that religion is a sort of universal obsessional neurosis, if not an outright delusion. God, according to Freud, was nothing more than the infantile figure of one's earthly father in the form of conscience carried on into adulthood. He expressed the hope that mankind would soon outgrow all such infantile nonsense. Freud held that one becomes neurotically ill because of an oppressive conscience of the religious variety, that recovery or salvation comes only through decreasing the rigidity and severity of the conscience and encouraging greater expression to the instincts through the therapeutic technique of psychoanalysis.

Freudian psychology provided the second line of evidence to support modern man's claim to be independent of God. Psychoanalytic theories accounted for the personal experience of religion in a way that caused theologians to stagger. One could hardly claim that his spirit met with God and still remain intellectually respectable. After all, psychoanalysis had demonstrated that the meeting was with the image of one's natural father. Indeed, the holy of holies *had* been shattered.

It might also be added incidentally, that the other great source of inspiration to modern psychology, namely, learning theory has been quite generally "connectionistic" and behavioristic in its orientation and as such had little use for the concept of consciousness in its formal scheme. According to this view, behavior is essentially reflexive and mechanistically mediated by bonds, with no room for evaluated, judged, intelligent behavior. The denial of consciousness and thereby moral responsibility was obviously out of sympathy with the Hebrew-Christian concept of man.

The response of those who stood in the Hebrew-Christian tradition to Freud and Darwin can be characterized by two words: readjustment and rejection. Many Christians attempted to readjust Christianity and science to each other. They took on themselves the task of salvaging the fragments of Christianity, fitting the least offensive of these into the new scientific frame of reference. Christianity came off second best in the deal. Christ was placed on the evolutionary scale along with the rest of mankind. The species of religion called Christianity was examined for its natural origins and for its evolutionary development. The assumption underlying such thinking affirmed that man was leading himself through some kind of conscious evolution to realize his highest possibilities, and that all psychological, historical as well as religious development should be evaluated in the light of that assumption.

Psychoanalysis also radiated itself through Christianity. Release from repression and guilt, deliverance from the absolute moral order, rationalization of sin, the equating of salvation with trying to do good,—concepts such as these produced mutations in evangelical Christian doctrines that eventually produced a hybrid religion of quite a different order from historic Christianity.

The response of rejection to the new state of affairs took two forms. First, many Christians rejected Christianity as intellectually indefensible. They capitulated to science. They poured their energies into the creating of a new world order by means of science and education. If they did maintain any semblance of Christianity it was compressed into a narrow ghetto of their private lives and somehow kept separate from their scientific and other professional endeavors.

In the second place, other Christians violently rejected science and invested all their energies in propagating a sort of non-intellectual Christianity. Their reaction was epitomized in the slogan, "The devil tempted Eve with the Tree of Knowledge; and he has been using the same approach ever since." Their position made it hard-

er than ever to develop an intellectually sound and relevant Christianity. To many, both within and without orthodox Christianity, it seemed that if such people were the true representatives of Christianity, then surely it must be a mere escape from rationality and reality.

The unhappy options with which a Christian scholar has been confronted up to the present are what Albert Outler[10] calls an anti-Christian intellectualism or a Christian anti-intellectualism.

A few hopeful signs are beginning to appear on the horizon. None of them are bigger than a man's hand, to be sure, but they provide new alternatives for the Christian scholar in place of the unhappy options described above. These signs may indicate that the eclipse of the Hebrew-Christian tradition is passing and that people are beginning to respond once more with sympathy and spontaneous understanding to evangelical thought.

One such hopeful sign is this conference and the existence of the two bodies that are sponsoring it. Another is the increasing flow of literature from the pens of evangelicals.

Let me sketch in briefly other hopeful signs in two other crucial fields, biology and psychology.

Nowhere has modern, orthodox Christianity suffered so severely in my estimation as in the lack of a positive general theory of origins and development. It is not that Christian men both within and without science have not vigorously attacked the Darwinian concept of evolution. Generally, however, they have been unable to offer a substantial cosmology or cosmogeny as an alternative to it.

Recently, however, a relatively unknown scholar, James L. Baldwin, has written a little book entitled, *A New Answer to Darwinism,* which, in my judgment, merits the most serious attention of every Christian concerned with the problem of origins and development of species. This little book is the forerunner of other expanded volumes dealing with the problems in greater detail. One feature of the work is the manner in which evidence is combined with speculative considerations to provide the foundations of a cosmology and cosmogeny that is compatible with basic scriptural references to this problem.

The major dimensions of Baldwin's formulation are as follows:

1. Evolution of species and individual growth are basically one and the same process. This process involves the continuity of germ cells from generation to generation and the progressive activation of recessive genes with the production of novel factors without mutations.

2. The process of evolution and growth is carried forward primarily by forces and structures within the organism, in its genetic makeup, not by chance mutations and natural selections. The growth and development of species is predetermined by patterns created by God in the genes.

3. Species existed first in unicellular form and have grown from determining factors implanted in the primordial genes.

The formulation encompasses other problems such as the meaning of the term "day" in the creative process, origins of the land masses of the earth, the relationship of the origins of the land masses with the creation of species, subsequent parallel development of species, structure and operation of genes from electrobiological point of view, electro-magnetic forces that were involved in the evolutionary process, an entirely new field concept solution to the similarity of species.

This line of investigation is all the more promising in that it is a modern vindication of the concepts of such great thinkers as St. Augustine and St. George Mivart. If Baldwin's formulation of the origins and development fulfills the promise it holds, Christians will have not only a positive scientific system to flank their religious convictions, but also another immense field of investigation suggested by it that they may explore on their own terms. Such a fundamentally Scriptural-oriented interpretation of facts in the field of biology seems to me to be a prerequisite for similar interpretations in other fields, notably psychology.

At the present time there is considerable disarray in the field of psychology. This in itself is a hopeful sign from the point of view of the Christian psychologist. The dominant positions of psychoanalysis and psychology of learning are seen as less-than-completely satisfactory by psychologists themselves. In psychoanalysis there is greater emphasis on ego-psychology, that is upon will, judgment, rationality; in learning theory there is greater recognition of the role of choice in behavior than there has been heretofore. These renewed emphases now being introduced into the field stand opposed to the classical positions of Freudian psychology and the psychology of learning, and are certainly more congenial to Christianity than the classical formulations had been.

One of the most glaring weaknesses of contemporary psychology still remaining, however, is its abysmal lack of understanding of the genius of the Hebrew-Christian faith. In my opinion the present formulations in psychology are hopelessly inadequate at the point where they touch religion. The only varieties of religion modern psychology knows are first of all a humanistic, existential Christianity whose goals and methods seem to be no different from those of professional psychology itself. Psychologists actually stand in a consultative relationship to such religion, teaching ministers how to counsel better and how to show people the way to find themselves. The other variety of religion recognized but rejected by most psychologists is what they describe as an unattractive, indefensible, pathological kind of

whom Calvanists in general and Jonathan Edwards in particular are the worst examples. Most of us would probably also be placed in this category also.

Wherein lies the challenge to Christian psychologists? First they need to make a clean distinction as Outler[10] does between discursive and evangelical truth. The latter lies in the tradition of the Greeks and Romans. It is the rigorous pursuit of truth. It is embodied in the scientific enterprise. Its methods are the methods of science, logical thought, rational inquiry.

The existence of a second mode of truth needs to be asserted and demonstrated. This might be called evangelical truth, and is quite different from discursive truth in methods and purposes. It is to be received and appropriated, not pursued. Faith is its method. It is embodied in Christ, not science. It springs from Nazareth not Athens or Rome. It is the truth that really makes men free.

Much of the confusion of modern psychology stems from the failure to distinguish between these two kinds of truth. Existential psychology strives to find truth of the evangelical kind by discursive methods. I believe the most competent minds in Christian psychology need to analyze the existential-psychological approach and show its futility in finding ultimate meaning in life.

The second challenge to Christian psychologists as I see it, is to work out a comprehensive and systematic doctrine of man, anthropological in the broad sense, that will compete on the market place of ideas with other scientific theories of man. The theory needs to encompass all known facts; it should draw from many disciplines; it should be based on broad fundamental principles.

Such a positive doctrine is as conspicuously lacking as a comprehensive theory of origins and development has been up to the very recent past. We have not given modern man a choice or option that is real. I find with students, for instance, that psychoanalytical theory has real appeal almost against the wishes of the students partly because there is nothing rooted in the Hebrew-Christian tradition that can compete with it. What has been produced to date is either a modification of existing psychological theories, or scientifically beefed up theological doctrines.

Whoever takes on this task of developing a new theory of man will have to deal with problems ranging from philosophy and theology on the one hand to the new quantum physics on the other. To be sure many aspects of this problem have been attacked now and again by very competent evangelical writers. The total problem needs to be encompassed, however, on a comprehensive systematic basis. Perhaps it is too much to hope that a Christian scientific doctrine of man might be so monumental that one would be forced to choose between it and other contemporary doctrines in essence in order to remain intellectually honest.

In my thinking about the challenge that the fields of biology and psychology hold to the Christian scholar, I began to ask myself what were the criteria that should characterize such research? What guidelines might be followed by those interested in such endeavors. If I may, I would like to present five characteristics for your consideration.

1. Such research should be both ruthlessly scientific and unequivocally evangelical. It must encompass all established facts, including those given in evangelical truth. It should stem from the thinking of both the great men of science and philosophy on the one hand and also from the work of the great spiritual men and theologians on the other—from Moses through St. Paul, St. Augustine, Calvin and a host of others.

2. Such research needs to be fundamental. That is, it must be based on primitive, elementary, unitary principles in so far as possible. The human will is an example of a fundamental concept, I believe. Although it is elaborated in many forms it is basically an elementary, primitive aspect of the human organism.

3. Such research should be integrated, synthetic. That is, it should combine facts and fundamental concepts from many fields, even widely divergent fields. I am becoming more sure, for example, that many kinds of electro-magnetic phenomena have a direct bearing on psychology. Generally speaking the array of scientific facts is already available; we do not need to produce new facts in order to get started. What is needed is a new frame-of-reference for interpreting facts more adequately than can at present be done. The final outcome of these efforts to integrate sciences and religion should permit one to start from any discipline and from it cover basic postulates that are implicit or explicitly found in other disciplines and that are congruent with Christian doctrines.

4. The research must be relevant. In their scientific endeavors Christians should deal with the same phenomena that secular scientists do. They may deal with others besides, of course. Only in this way can the argument be joined and a decision or agreement reached. In the past, Christianity has often failed to consider the same problems as did science, hence their ways parted and science had the best of it. In the future, it may be that the situation may be reversed.

5. The research should be broadly evangelistic in intent, and aimed at the intellectual segment of society, especially students. The research efforts of Christians should prepare an intellectual, emotional, and social context that will allow the voice of Christianity, Christ, a sympathetic, responsive hearing. Let me illustrate what I mean. Will you imagine with me a world in which along side the Darwinian theory of evolution is a Christian theory of evolution that is based on every scientific fact which Darwinism is based and more besides, that does full justice to every Biblical utterance,

and yet controdicts Darwinian interpretation on every relevant issue? Such a theory would offer a true option to Darwinian theory. Now imagine a similar situation for psychology, anthropology, economics, *etc.*, making allowance for areas of agreement as well as for contradiction. Intellectuals and students might not believe the Christian interpretations of science, but they at least would not be forced into an anti-Christian intellectualism by default. Such a situation would promote evangelism on the campus by tending to stop the mouths of skeptics and scoffers.

In closing, I wish to make a few observations on a problem which I imagine all of us face at least to some extent. Most of us can probably devote no more than mere snatches of spare time to do the kind of synthesizing research that I am referring to here. After a full day of teaching, reading students' papers, preparing sermons, spending a minimum amount of time with wife and children, we try to devote a few paltry moments to reading and thinking about these most vital problems. It seems to me that if progress is to be made in developing a general Christian philosophy of science and if we are to progress in specific lines of research more Christian men of science are going to have to devote larger blocks of time to it than they are able to give at present. Until they do our progress is likely to be much slower than it should be.

I would like to propose, if it has not already been done, that the organizations sponsoring this conference take a lead in establishing machinery for providing extended fellowships and research grants for the purpose of encouraging research toward this end. Invitations could be sent out to the membership to submit research proposals. Grants could be made on the basis of a summer, a semester, or a full year. They should be of sufficient amount to enable the recipient to move with his family to a university center, a research library, or specialized laboratory where study could be carried on free from administrative, teaching or other pressures. A fund for such grants might be sought from contributions from the membership or from one or more foundations that might be encouraged to support such endeavors. Perhaps an institute might be established for the dissemination and interchange of information gained from such research. In fact, such an institute might become the seed from which a new Christian university or research center might spring.

I have attempted to describe the challenge confronting the Christian men of science, especially from the viewpoints of biology and psychology. I have sketched briefly the lines in which I think further efforts should be directed. These are not necessarily the only or the best directions. I am firmly convinced, however, that organized, well financed, concerted efforts are necessary to supplement the efforts of lone individuals working on the fringes of their time and energy.

REFERENCES

1. Baldwin, James L., *A New Answer to Darwinism,* Chicago: Evangelical Publication, 1956.
2. Brunner, H. Emil, *Man In Revolt: A Christian Anthropology,* O. Wyon, translator, New York: Scribners' Sons, 1939.
3. Cassirer, Ernst, *An Essay On Man,* New Haven: Yale University Press, 1944.
4. Darwin, Charles, *The Origin of the Species,* New York: New American Library, 1958.
5. Freud, Sigmund, *The Future of An Illusion,* London: Hogarth Press, 1928.
6. Genesis 1:26, 28.
7. Genesis 3:15.
8. May, Rollo, *Man's Search For Himself,* New York: Norton. 1953.
9. Otto, Max, *Science and the Moral Life,* New York: New American Library, 1949.
10. Outler, Albert, "Quid Est Veritas?" Proceedings, Inaugural Dinner, Council of Protestant Colleges and Universities, 1959.
11. Pollard, William, "Dark Ages and Renaissance in the Twentieth Century" in *The Christian Idea of Education,* Ed. by Edmund Fuller, New Haven: Yale University Press, 1957.
12. Rank, Otto. *Beyond Psychology,* Camden: Haddon Craftsman, 1941.
13. Riesman, David *The Lonely Crowd,* New Haven: Yale University Press, 1950.

BIOLOGY

I. W. Knobloch, Ph.D.

Some Recent Points of View on Certain Aspects of Evolution

Mutations-"it was formerly held that conspicuous mutants or sports were important in evolution but few people still hold this view. If one calls a polyploid (an organism in which the chromosome number has been doubled or more—this frequently looks quite different from the parent or parents) a mutant, then this phenomenon is an exception to the prevailing opinion. The modern point of view is that species arise by small additions much as Darwin envisioned the matter."

The incompleteness of the fossil record-"the remains of most of the species which have existed, have never been preserved" (consider the difficulty of preserving the soft-bodied animals and plants). "The fact that an animal stops appearing in the fossil record is no proof that it does not continue to exist" (paleontologists and paleobotanists date the rise and fall of organisms by the presence or absence in the rocks. "A case in point is the coelocanth. This fish appeared 270 million years ago and disappeared about 60 millions of years ago. It had, apparently, become extinct. However, this same species is being taken occasionally off the coast of Africa today" (in this case, the fossil record was not very trustworthy- and continuing the reasoning, may not birds and mammals have existed in the Cambrian but left no remains?)

Complex inter-dependence as a stumbling block-"Maculinea arion (L.), the European large blue butterfly, lays her eggs on the flower heads of wild thyme; the young larvae feed on these for a few weeks. On the 7th abdominal segment is a small gland which if stimulated, produces a drop of sweet fluid. Ants milk the larvae for this juice. In about 3 weeks, the larvae begin to move about on the ground and if an ant milks it repeatedly, the larvae expands its body behind the head and in front of the gland. The ant seizes the expanded portion and drags the larvae into its nesting area. Here the larvae feed on the young of the ant. After hibernation, the larvae starts feeding in the spring, it then pupates and, in about 3 weeks, emerges as a butterfly. An even more remarkable example is the brown Argus, *Aricia agestis* (Schiff.) which cannot live at all without the ant because the ants are necessary to clean out a fungus which grows in the sweet fluid of the gland" (there are many such instances in the literature which are difficult to explain by evolution but I am going to take the position here that change is characteristic of life and that someday we may be able to explain such phenomena by the action of mechanisms not known with any large degree of certainty today. It seems just as unscientific to deny the existence of changing species as it is to insist that organic evolution, from simple to complex, has been proven)

The above three examples were taken from "Natural Selection and Heredity" by P.M. Sheppard, London, 1958. The comments of the writer of this column are in parentheses.

The Pugwash Continuing Committee

A conference was held in Austria from September 14-20, 1958 on the effects of war on mankind. Scientists from many countries, including those behind the Iron Curtain, attended and the Vienna Declaration resulted. Those who are interested, may learn more about this by writing Dr. Rabinowitch, Box. 61,5734 University. Chicago, 37, Illinois. A few sentences from the Declaration might show the nature of the document—

"the development of nuclear weapons makes it possible for man to destroy civilization—"

"a full-scale nuclear war would be a world-wide catastrophe of unprecedented magnitude"

"defense against nuclear attack is very difficult"

"although the nations may agree to eliminate nuclear weapons—the knowledge of how to produce such weapons can never be destroyed"

"if, in a future war, a substantial proportion of the nuclear weapons already manufactured were delivered against urban targets, most centers of civilization in the belligerent countries would be totally destroyed, and most of their populations killed".

New Ideas on Plant Evolution

In a recent article by K.R. Sporne (On the phylogenetic classification of plants-*Amer. Journ. Bot. 46*: 385-394, 1959) some very frank admissions are made concerning plant evolution. This article is recommended for those interested in this subject. Dr. Sporne does not decry evolution but he points out the fallacious reasoning used by strong advocates of the theory.

Algae are classified on the basis of their pigments and, of course, these are lacking in fossil forms. Furthermore only lime or silica-secreting species were preserved and nothing can be known of the other species which existed at that time. Algae may have changed but not evolved since the early algae were not simpler than present day forms. In regard to the fungi, the phycomycetes seem to antedate the other two groups. The Bryophytes are found in the Carboniferous and they furnish few clues to evolution since liverworts of that time can be matched with living Jungermanniales. Ferns and fern allies are well-represented in the rocks. If the discovery of *Aldanophyton*, a lycopod from the Cambrian of eastern Siberia in 1953 by Kristofowitch can stand scrutiny, the ancestry of these plants goes back almost to the beginning of fossil time. We would certainly have to stop deriving ferns from the mosses as the earlier evolutionists insisted.

As the above few notes may indicate, the article is very provocative and well-worth reading by those with some background.

Several Interesting Admissions

"The all-too-frequent picture of evolution as a progression from ameba to man, is, and always has been, utterly without foundation". This can be found on page 655 of *The Science of Biology* by Paul B. Weisz, McGraw-Hill Book Co. 1959. I had always thought that organic evolution implied that there had been such a progression from simple things to complex things. It has taken an evolutionist of the stature of Dr. Weisz to straighten me out on this matter. Incidently, his statement is more or less contradicted by his chart on page 675 which shows everything starting from "viruslike types".

"Classification of animals to this day practically always begins with Protozoa and ends with Vertebrata (which in turn begins with cyclostomes and ends with mammals). Some taxonomists vehemently deny that this is a sequence from lower to higher (although students are usually *told* that it is)." George Gaylord Simpson says this in an article dealing with anatomy and morphology, Proc. Amer. Phil. Soc. 103(2): pp 296. Incidently this volume number is given over entirely to modern views on evolution and celebrates the anniversary of the publication of Darwin's *Origin of Species*. The material is well worth reading and the number can be purchased for $1.00 from the American Philosophical Society.

CHEMISTRY

Walter R. Hearn, Ph.D.

This column is being written soon after the author's return from a week of evangelistic effort on the campus of the University of Alberta in Edmonton. The University Christian Mission there was sponsored by all of the protestant student religious groups on campus, who agreed on the following statement of the Aims of the Mission:

"1. To confront the University with the claim of Jesus Christ, the Son of God and Saviour of the world;

2. To show the relevance of faith in Jesus Christ
   a) to the pursuit of truth
   b) to the personal life and to the eternal welfare of every individual
   c) to the great social issues of our age;

3. To present the urgent need of our day for intelligent, trained, and consecrated Christians in all walks of life;

4. To help members of the University community to better serve Jesus Christ and His Church."

The strategy of the Mission was to schedule talks by the eight visiting missioners throughout the week on the relation of Christianity to their own fields of endeavor, and to have the missioners conduct discussions and "bull-sessions" in residence groups each evening. From the questions asked by students after a formal talk or during one of the bull-sessions it was relatively easy to distinguish the earnest seekers from the "hecklers"; one could then make appointments with the former for further private conversation about the claims of Jesus Christ. By and large the strategy seemed to be effective: there were a number of very fruitful contacts which are now being followed up by correspondence and by mature Christian students on the campus.

It is customary to invite one or more scientists to serve on such a team, and I know of several A.S.A. members who have been participating in this form of campus evangelism. From time to time some of us receive invitations we cannot accept, so it would be good to hear from others who would be willing to do this sort of thing occasionally so you could be recommended when invitations come. My own policy is to devote one week each year to this kind of evangelistic activity and I have learned to make this policy clear when being interviewed before accepting a new position. In fact, it was a sympathetic employer who suggested the policy of limiting myself to one week each year, in order to be fair to my colleagues on the staff. I have found most department heads willing to regard such activity as a legitimate professional responsibility, similar to giving technical lectures on invitation—especially these days if I promise to snoop around for prospective graduate students while on other campuses! Sometimes missioners or "Religion-in-Life Week" speakers are asked to lecture on their own research to a faculty or student group during the week in addition to giving strictly religious talks. At some colleges, there are invitations to address regular classes during the day, my invitations usually being to chemistry or biology classes.

After a week of giving several talks each day, meeting dozens of students and faculty members, and being bombarded by questions far into the night, one is fully aware of the paradoxical importance of both thorough preparation and thorough dependence upon the Holy Spirit. What a frightening responsibility to know that you must say the right thing to a student who is groping his way toward Christ, without knowing exactly what the right thing will turn out to be! Undoubtedly any earnest evangelistic effort involves intellectual, emotional, and spiritual strain of this kind, but it seems particularly intense on a college or university campus. The atmosphere at a university is one of open inquiry and challenge of authority (and quite rightly so, I think); in such an atmosphere it is often particularly difficult for a young person to give himself to Christ, or indeed, to commit himself to anything at all. Furthermore, he

may have been forced into making false choices already, such as having to choose between "the Bible and science," as one student said his minister had put the choice to him (He chose science!). And of course there is the tension provided by the real hecklers who have aligned themselves against Christianity, sometimes on the flimsiest grounds imaginable, who feel compelled to attack any intelligent Christian witness lest its effectiveness threaten their own position!

It is encouraging, refreshing, and sometimes downright amazing to see the variety of ways in which the Lord attracts students to Himself, sometimes through what we have to say and sometimes in spite of it. How wonderful it would be if we could get across to Christian students now in college that every idea, every bit of information, every course they take, can be of value in their witnessing to educated people as well as being useful in their future occupations. I always come back from a week of campus evangelism with an urgent list of things to read up on, ranging from Zen Buddhism, theology, and politics to quantum mechanics, evolution, and astronomy. Whenever some topic is touched on in a conversation with a non-Christian I praise God for even a smattering of knowledge that helps to break down barriers to the communication of the Gospel, and resolve not to be satisfied with merely a smattering. Some of my acquaintance with other fields of science has come through contacts with other members of A.S.A. through the years, for which I also praise God. Incidentally, participation in campus evangelism provides excellent opportunities to spread the word about our Affiliation and to recruit new members. We already have one new applicant from the U. of Alberta!

One of the talks I gave during the Mission was scheduled for the medical building and directed primarily toward medical students. It was entitled "A Biochemist's View of Life" and was in the form of a modern parable, a sort of analogy between physical life and spiritual life as seen by a "mechanistic" biochemist. The gist of that talk will be presented for your criticisms in the next issue of this column. Basically, it was an attempt to describe the nature of Christian experience in language acceptable and understandable to students raised on physics and chemistry rather than on the Old and New Testaments. It seems to me that we are often terribly careless in our approach to non-Christians with the Gospel of Jesus Christ, especially to people in our own cultural setting. Anyone can see the necessity to learn good Spanish or Portugese in order to preach the Gospel in Latin America, but how few of us take the trouble to speak good Existentialism, or good Evolution, even if that is the particular "language" being spoken at the moment by those to whom we witness! Even the most agnostic student seems to listen attentively when we try to describe what being a Christian really means to us, if we are patently honest and make at least some effort to put our experience into his language. After all, if he is sincerely agnostic he is interested in new evidence, and our experience is evidence which he could not already have. Often, when effective communication has been established it becomes obvious that his "language of experience" is *not* adequate to describe what we are trying to convey, and the real issues of Christianity are made abundantly clear at this very point. Much time beforehand must often be spent in clearing away intellectual roadblocks, getting rid of pseudo-problems, and simply in showing by our consistent faith and concern for him as a person that our evidence is worthy of consideration.

One approach to science students is to show that science itself involves commitment—that one becomes a Christian in essentially the same way one becomes a scientist: by a personal, conscious choice. Many undergraduates have such an oversimplified concept of science that they have no idea at all of the importance of subjective choices in the day-to-day business of doing research. Barriers to faith are often broken down when a student is helped to see that science is not wholly objective and Christianity not wholly subjective. I have found this important to emphasize to students who seem afraid to consider becoming a Christian out of fear of losing their objective approach, so valuable to a scientist. To show them that I have not lost mine by becoming a Christian, I often say that Christianity is a "working hypothesis" for me. That is, I try to remain open to new evidence that might conceivably overthrow my faith, but my commitment is sufficiently firm on the basis of presently available evidence that I do not wallow in doubts or dread further investigation. As an illustration, I try to show how a scientist actually proceeds in the laboratory. He has to make assumptions in order to plan new experiments, knowing that someday an experiment might overthrow even his most firmly held assumption; his faith in his assumptions that are not overthrown is strengthened by the results of his experiments even though sometimes his interpretations may later be shown to be incorrect. The point is that his realization that he might be wrong (and probably *is* wrong in at least some of his ideas) doesn't keep him from committing himself to his assumptions for the purpose of designing and carrying out new experiments.

Of course, as a Christian one must be honest about his openness to new evidence which may affect his faith if he is to take this approach. In my own experience I have found that demonstration of this openness provides a most effective avenue of approach to non-Christians. That is, I *do* consider every intelligent non-Christian with whom I come in contact as a new piece of evidence: he may know something I do not know which has kept him from becoming a Christian. If so, I had better find out what he knows! It may be embarrassing

to "give our testimony" for Christ at times when nobody has asked for it, but it is never embarrassing to "share our testimony" with each other—my testimony that Christianity is true, and the non-Christian's that it is false! If it *is* true, Christianity will stand up under cross-examination, and the fact that it stands up is powerful evidence that it is true.

Unfortunately, many evangelical Christians do seem to take a thoroughly dogmatic attitude toward their faith, and do seem to be afraid of even considering new evidence. Such an attitude not only makes them ineffective witnesses among almost any group of people who see the value of a scientific point of view, but must also deprive them of much of the excitement and "abundance" that should be characteristic of a life of faith. In fact, one could almost say that they cannot be leading lives of faith at all, since genuine faith welcomes the exploration of new paths of thought. It seems to me that members of the American Scientific Affiliation can be of great help to other evangelicals by showing them that dogmatism is as out of place in genuine Christianity as it is in genuine science. One way to demonstrate to our fellow Christians the value of an "experimental" approach to faith rather than a dogmatic one is to show that it is actually more effective in bringing college students to living faith in Jesus Christ.

PHILOSOPHY

Robert D. Knudsen, Ph.D.

In this issue we continue the column which was begun by Professor Vivian Dow. Discussing the topic, "The Christian Faith and the Public School," Miss Dow investigated various sources of unfriendliness to the Christian religion in the public schools. Her conclusion was that our public schools are unfriendly to anything but the vaguest kind of religion and that the pupil could hardly avoid gaining the impression that if there is a God at all he is not of vital importance. Her article closed with the question, "What is the Christian answer to the situation?" In this second installment she gives her provisional answers.

The first and most obvious answer, of course, is the Christian school. Possibly it is the best answer. A great number of Christian schools are now in operation and they undoubtedly deserve more whole-hearted support than they receive from the majority of Christians. But loyalty to the cause of Christian education and the Christian school should not blind us to the problems and flaws that exist.

One of the worst problems is the financial one. Not every family can afford a private school; nor can the Christian school, operating within a limited budget, always provide adequate facilities and a salary designed to attract topnotch teachers. Another problem is a satisfactory Christian philosophy of education. Several well-known Christian philosophers have attempted to meet this need, but the results are somewhat disappointing; most of them are "too heavenly minded to be any earthly good" with reference to such practical matters as educational methods and curriculum. The result is that the Christian school is in danger of being merely a secular institution baptized into Christianity with Bible reading and prayer before class. The curriculum, the textbooks, and the teaching procedures are identical with those of the secular school, and the teachers, while they are dedicated Christians, are nevertheless, as graduates of secular schools of education, unwittingly indoctrinated with an educational philosophy and psychology which is incompatible with the Christian view of nature and man.

Space will permit only a bare mention of other problems, such as the psychological and social effect on the student of being separated from his neighborhood associates to attend a private religious school, and the effect on his scientific, social, and theological concepts of an obscurantism that often characterizes the evangelical elementary and secondary school-teacher. I believe the Christian school is performing an important function and should be supported; but it needs strengthening and improvement if it is to counteract the paganism of our modern world.

A second answer to irreligion in the schools is denominational religious instruction. In some areas there is a program of released-time instruction. Even in areas where released-time classes are not feasible, the church could provide a program of instruction if the Christian community were sufficiently interested. If the instruction is to be successful in the released-time program or in the church program, however, the church must see to it that it is of topnotch quality and the parents must support the program by attitude, example and precept. Slipshod teaching about God and parental indifference to religious instruction can only foster the impression in the mind of the child that God is not important enough to command the quality of effort devoted to secular matters by the public school. Too often this is the situation.[1]

There are many other answers to the problem, no doubt. One of the best is a home environment and home instruction that is distinctively Christian. The family that gives God top priority in the affairs of daily life is counteracting the godless effect of the public school. Mere Christian environment, however, is not enough; it needs the addition of specific instruction in Christian doctrine and ethics. Speaking from my own experience as a professor in a college drawing most of its students from the evangelical group, I would say that the religious knowledge of the average Christian young person would hardly fill a peanut shell. Juniors in college who are ardently evangelical but who can read Swedenborg with unruffled approval and who cannot name the writers of the four gospels can hardly be considered reli-

giously educated. Few students entering the college from Christian homes had read even the New Testament completely through at least once, to say nothing of the entire Bible. Such ignorance on the part of Christians of the fundamentals of the faith is inexcusable. Why are the home and the church not doing a better job of instructing the child? We need to read again the injunction of Deuteronomy 6:7 concerning the instruction of our children in the Word of God.

My final point is that the real answer to irreligion in the public schools of America is an evangelical Christianity that is making a vital impact on our society. We need a clear and modern enunciation of our faith; and by this I do not mean a modernistic or a modernized enunciation, an enunciation of something other than the faith once and for all delivered to the saints. Neo-orthodoxy has given us that. I mean instead that we need the kind of informed, doctrinally educated, positive, and vital New Testament Christianity that can and will make a difference in civic and educational affairs. We need laymen who are awake to the real enemies of the Christian faith, not Don Quixotes making Christianity ridiculous by fighting the windmills of movies, makeup, and modern translations of a Bible they fail to read in the Authorized Version.

We need to develop a clear philosophy of science, offering a satisfactory alternative not only to atheistic evolutionism but also to the egregious misinformation that plagues the Christian community, the complex of misconceptions derived largely from the writings of certain self-styled scientific experts of a generation gone, whose Christian zeal was more laudable than their competence.

We need to encourage Christian young people to enter the teaching profession. The public schools of America would be more godless than they are were it not for the Christian teachers whose example and attitudes in the classroom speak in defense of religion even when their lips are silent. We need also to strengthen the education departments of our Christian colleges in order to provide these young people with the kind of education that will enable them to evaluate critically the psychology, philosophy, and education theory underlying the methods and materials they use in the schools. We need in addition to develop more Christian graduate schools so that our young people can prepare in a Christian atmosphere for careers in science, in government, in education, and in all phases of human endeavor.

We need to open the eyes of Christians to the possibility of writing textbooks for the schools, both public and parochial, and to opportunities in school administration on national, state, and local levels. We need also to encourage Christian parents to interest themselves in their local Parent-Teacher Associations and school boards. This is a nation whose first and greatest schools and colleges were established for the purpose of training students for the Christian ministry because its society was liberally flavored with the "salt of the earth." If our public schools are irreligious, we Christians are partly at fault, and we ought to do something about it.

1. Cf. Waterhouse, Howard A. "Is Released Time Worthwhile?" *The Christian Century*, LXXIV, 40 (October 2, 1957), pp. 1164-1166.

SOCIOLOGY

Russell Heddendorf, M.A.

At the root of social action theory is the problem of rationality which centers in the question of whether the individual can be completely objective and rational in his achievement of ends. The Christian has always realized that such objectivity in social action was not possible; he was willing to admit, for one thing, his ignorance of appropriate means and ends. It has only been within the past several decades, however, that sociologists have begun to state the obstacles to a theory of purely objective social action.

Although this work was initiated by Max Weber in a more preliminary form some years ago, it was in the work of Talcott Parsons that the problem became more concrete and gained new dimensions.In addition, the presentation of the concept of unanticipated social consequences by Robert Merton indicated that useful and worthwhile functions might result from social action which was not, frankly, completely objective. It remained for Kingsley Davis, therefore, to popularize the notion in his classical statement on the problem of rationality.[1]

Briefly, Davis extracts four main reasons for action deviating from a rational course:

a) The existence of superempirical ends—Such ends may be goals which exist, not only In the unknown future, but perhaps in a completely different world. Hence, they are goals which are not a part of the present time-space culture. For this reason, the culture has not indicated the desirable means to be used in achieving these goals and any means chosen to achieve these ends might be in error since there is no empirical knowledge of a cause and effect relationship.

b) Uncertainty of ends—The emphasis of such action is on the means without any clear realization of what the resultant ends will be. This action does not presuppose the existence of no end, as in an instinctive behavior, but may result in any one of several possible ends.

c) Ignorance—The great number of possible means which may be used to reach a particular end may prevent the actor from making the correct choice because of lack of knowledge of all of the means or, at least, of the appropriate one. The possibility of making errors

in social action as a result of ignorance in our society is particularly great because specialization provides for a great many legitimate means which are not within the frame of reference of the layman.

d) Normative restrictions—In this case, a particularly effective means for achieving an end may not be chosen because it is not morally acceptable in the culture. In addition, the actor is restricted in the choice of certain means because if they were chosen, he might be prevented from gaining other ends.

For these reasons, man is not entirely rational in his social action; he is not able to choose the best means-end relationship for any particular activity. His social action is to be filled with error and failure, though on many occasions he will be surprised to find that such error will result in an unexpected benefit. The individual, therefore, must accept irrationality in his social action, although "there is a correlation between rationality and success which would be perfect if the actor were omniscient and omnipotent."[2]

For the Christian, of course, this "irrationality" of social action is accepted and should form a part of his daily choices of means-ends relationships. His actions on some occasions will be "non-social" because a) he will be motivated towards superempirical ends, b) he may feel called to perform a particular action even though he doesn't know what the ends will be, c) not being oriented to the means offered by the culture, he will be ignorant of many alternative means offered by his culture, d) he will be constantly limited in choice of means by Biblical precepts. Yet as the Christian relies on the omniscience and omnipotence of God, his actions become "rational", though "irrational" by the standards of his culture.

In a Christian culture, the irrationality of the social action becomes rational. This was true, for instance, of Puritan America. Since it is possible for irrational social action to become rational with a change in the cultural milieu, it seems to be an essential sociological task to study the elements of irrational means-ends relationships. Indeed, it might even be more important for the task to be accomplished in a day when the "irrational" remains as such, for it would not only provide for a reevaluation of the non-Christian's dependence on rational social action but also provide additional credence for the Christian's understanding of social action.

[1]Davis, Kingsley, *Human Society*, Macmillan, New York, 1948, pp. 128-133.
[2] *Ibid.*, p. 133

BOOK REVIEWS

The Death of Adam: Evolution and Its Impact on Western Thought. John C. Greene. Iowa State University Press, Ames, Iowa, 1959. 388 pp. $4.95.

Reviewed by W. R. Hearn, Asst. Prof., Dept. of Biochemistry and Biophysics, Iowa State Univ. of Science and Technology, Ames.

There is no better way to introduce this excellent book by a professor of the history of science at my own university than to quote the first paragraph of its preface:

"This is a book about the rise of evolutionary views of nature and the decline of static creationism in the two centuries separating Isaac Newton and Charles Darwin. The title suggests the latter side of the story. I write as a historian, not as a biologist, theologian, or philosopher. My purpose has been to describe analytically and synthetically the tremendous revolution in human thought which took place in the interval between John Ray's *The Wisdom of God Manifested in the Works of the Creation* (1691) and Charles Darwin's *Origin of Species* (1859) and *Descent of Man* (1871). I do not pretend to have covered all of the relevant developments in this period, but I have done my best to trace the leading ideas which entered into Darwin's great synthesis. I have allowed the men who accomplished this intellectual revolution to speak for themselves as much as possible. They have been portrayed, not as "pure scientists" (there are no such beings), but as flesh and blood individuals influenced by the general ideas abroad in their own age, yet working, wittingly or unwittingly, to transform them."

I most heartily recommend this book to all readers of the *Journal of the A.S.A.*, whatever their attitudes toward evolution. Selected as the winner of the Iowa State Centennial Award for the best manuscript written by a staff member during our centennial year, it has been lavishly illustrated and beautifully published by our University Press. Professor Greene brings to life in a carefully documented but eminently readable way the sequence of major discoveries in astronomy, geology, natural history, and paleontology that gradually changed man's concept of nature, sometimes foreshadowing the Darwinian theory almost explicitly, but more important, making its immediate popular acceptance inevitable once it was published. People today who are disturbed enough by evolutionary ideas to oppose them must realize that they are opposing not merely Darwin and his followers but the whole trend of thought about the nature of the world since the seventeenth century, a trend contributed to just as much by pious believers in the Scriptures as by agnostics. For twentieth-century Christians to think that they can reverse

that trend, or even to wish that they could, seems to me to be a tragic waste of spiritual and intellectual gifts. Anti-evolutionists in the A.S.A. especially should read this book, which is certainly written without either anti-fundamentalist or even pro-evolutionary bias; it is simply history, and most fascinating history.

I have had several opportunities to discuss the book with its author, who would classify himself, I think, as a Christian of more or less neo-orthodox persuasion. (Indeed, I once watched him rise to the defense of another Christian professor being challenged vigorously by a group of agnostic colleagues after a seminar.) He told me that the negative-sounding title, *The Death of Adam,* has been criticised by some conservative Christians, but the concluding paragraphs of the book show the sense in which the title should be understood: After discussing the impact of Darwin's *Descent of Man,* he asks if, as evolutionists often picture him, man is "ready and able to assume control of his own and cosmic destiny? Or is he, as the Bible represents him, a God-like creature who, having denied his creatureliness and arrogated to himself the role of Creator, contemplates his own handiwork with fear and trembling lest he reap the wages of sin, namely, death? The events of the twentieth century bear tragic witness to the realism of the Biblical portrait of man." If the author thinks that the development of science has made it impossible to take the *content* of the Genesis creation story literally, he still thinks there is every reason to take the *intent* of it seriously: "The historical Adam is dead, a casualty of scientific progress, but the Adam in whom all men die lives on, the creature and the creator of history, a moral being whose every intellectual triumph is at once a temptation to evil and a power for good."

Dr. Greene has been invited to give a series of lectures on the more theological aspects of the evolutionary controvery at the Rice Institute in the spring of 1960. I was glad to be able to present him with a copy of our own volume *Evolution and Christian Thought Today,* at the time those lectures are being prepared. He had not heard of the American Scientific Affiliation before but was interested in learning more about us, and of course about our attitudes toward evolution which I tried to convey in all their resplendent variety! His lectures at Rice are also to be published in book form this year.

Symposium on Information Theory in Biology. Editors: Hubert P. Yockey, Robert L. Platzman, and Henry Quastler. Pergamon Press, New York, 1958. 418 pp. $12.00.

Reviewed by W. R. Hearn, Asst. Prof., Dept. of Biochemistry and Biophysics, Iowa State Univ. of Science and Technology, Ames.

This is a stimulating, difficult, and expensive book. It consists of the papers and much of the discussion at a symposium sponsored by the Oak Ridge National Laboratory in 1956 on the application of information theory to biological problems. Information theory is a type of "General Systems Theory," as I understand it, which deals mathematically with the degree of "specification" of a thing (or condition or event): the degree to which a thing is specified can be described in terms of its "information content" expressed in mathematical symbolism. A highly random orientation is said to have a high "entropy of information;" a highly oriented system requires a certain amount of information (intelligence) to specify the whole system. Since living organisms are characterized by an extreme degree of orientation, it has been thought by a number of workers in various fields that the application of information theory might be useful in biology. For example, the Health Physics group of the Oak Ridge Laboratory was interested in the problem of radiation damage to living cells at the time of the symposium. An electrical engineer (from whose ranks the originators and many enthusiasts for information theory have come) would regard this problem in terms of the introduction of "noise" (randomness) into a system of high information content; if the "signal-to-noise ratio" is low, information will be lost and normal life processes will be disrupted.

The book is divided into the following sections: Introduction; Storage and transfer of information; Determination of information measures; Destruction of information by ionizing radiation; Aging and radiation damage; Information networks; and the Status of Information theory in biology. Two of the chapters are especially valuable to anyone like myself with no formal training in information theory. Quastler's introductory "Primer on Information Theory" not only contains definitions of terms and discussion of basic concepts, but also exercises to do which help one to be sure he has mastered the theory (with answers at the end of the chapter!). His chapter on "The Domain of Information Theory in Biology" later in the book is nonmathematical and very helpful to a beginner trying to orient himself in the field. Elsewhere, things get pretty complicated, and the problems dealt with are highly specific ones such as "Fluctuations in Neural Thresholds" or "A Probabilistic Model for Morphogenesis." Few readers will be able to get something out of every chapter in such a treatise, but the coverage is broad enough to offer something fascinating to anyone who has ever tried to think quantitatively about some problem in biology.

To me the most interesting chapters were those dealing with the "coding" of information on nucleic acid molecules and the translation of that code into the arrangement of amino acid residues in protein chains. There are three chapters which deal specificially with this coding problem and which describe the approaches to "decoding" that had been made up to 1956. This

problem lies at the very heart of a chemical understanding of genetics and is of vital interest to all biochemists. Unfortunately, the nature of the code has so far eluded the "molecular cryptographers" working on it feverishly.

The status of information theory in biology at present is candidly assessed in the final chapter: it has not produced many results so far; it has not yet led to the discovery of new facts, nor has its application to known facts been tested in critical experiments. "Vitalists" may find some comfort in this failure of "mechanism," but personally I think whatever comfort they find will be short-lived; the trend is obviously toward mechanistic solutions to biological problems and the limitations at present are often only the limitations of the availability of data. At any rate, don't miss the symposium of vitalism vs. mechanism at the Annual Convention at Seattle Pacific College in August!

The Heavens Declare. Maurice Thaddeus Brackbill Astral Society, Eastern Mennonite College, Harrisonburg, Virginia 128 p. $2.75

This little gem from the pen of Maurice T. Brackbill should be read by all who have an interest in Astronomy. Written from the Christian point of view, this book shows some of the wonderful harmony existing between God's World and His Created Universe.

A very fine introduction by Armand N. Spitz, director of Spitz Laboratories, points out that Professor Brackbill is a teacher of unusual inspiration. Spitz continues as follows: "He is a quiet, unassuming individual, in a quiet, unassuming college, representing a quiet, unassuming faith, in a quiet, unassuming community. Yet his influence has spread throughout the years."

The book is divided into seventeen short chapters and can be easily read by any teenager or adult who may have little scientific knowledge. However to gain a complete comprehension, the reader should have taken a standard course in Astronomy.

For the critical reader it should be pointed out that there are two errors of fact. On page 44 the mass of the sun is given as 6.6 times ten to the twenty-first power tons. This number really represents the mass of the earth, while the sun has a mass of 2×10^{27} tons. Then on page 106 it is stated that the entire number of subatomic particles is 10 raised to the exponent 100. This number is much too large. According to data avaiable today this number does not exceed 10 raised to the exponent 80. This is a very serious error for the number given by the author is one hundred billion billion times the more correct number.

In order to allow you to catch the flavor of this wonderful book, allow me to quote, "Moreover, God has His signatures all over the sky, identifying Him, and authenticating every star, a divine master piece, but it seems not all can decipher it, just as not everyone can recognize a Rembrandt painting or a Stradivarius violin. As a painting reveals its painter to the expert who knows the artist, and the statue reveals its maker to the master who knows the sculptor, so the heavens reveal their Creator to them who know their Originator."

"The Bible writers did not include any Galileos, Newtons, Eddingtons, or Einsteins, but they did have God! They did not have telescopes or spectroscopes or photographic films, but they did have the Holy Spirit!"

A most fascinating chapter is eintitled, "If the Stars Shone Only One Night Every Thousand Years." Note the intense anticipation of the star viewers as they shout, "The stars are coming! The stars ARE coming! THE STARS ARE COMING!" Professor Brackbill continues: "And amid the 'Ah's!' and 'Oh's!' and other exclamations from millions of throats along a pole-to-pole front, presently in the East, Sirius shines out, palely at first, and then Rigel and Capella. Star after star breaks through, singly, then by twos, by threes, soon by dozens, by fifties, by hundreds, bespangling the heavens in the deepening night. Oh, what a sight. What a ravishing vision of loveliness!"

"Concerning A Star and Me," is the title of one lovely chapter. Here the writer causes one to smile as he says,

> "Stars don't know anything. They don't even know that they are stars. No star ever had ideas about anything, not even about themselves. A star is an idealess thing. Not so, I have ideas. Really. Well, you are reading some right now."

The chapter on the Bethlehem Star concludes as follows:

> "If one Christmas Eve we cannot see Venus or a Nova, or a comet, or a conjunction as Prototype of the Bethlehem star, we can see the Cross planting itself upright in the low West, symbol of the purpose of Christ's coming two millenniums ago, its head pointing to Cepheus, the King, and its foot pointing to Sagittarius, toward the center of ur galaxy where peradventure, God has His throne, where Jesus likely went to His departure, and where He will come again. And who knows, it may be tonight."

This book should be read by everyone who loves both God's Word and His World. I can highly recommend it for its humor, scientific interest, and its Christian message. It honors both our God and His Son Jesus Christ. The closing message it takes from Psalm 148:

> "Praise Ye the Lord from the heavens.
> Praise Him in the heights,
> Praise Ye Him sun and moon,
> Praise Him, all Ye stars of light,
> Praise Him, Ye heavens of heavens,
> Hallelujah! Hallelujah!"

Reviewed by H. Harold Hartzler, Mankato State College, Mankato, Minnesota.

NEW MEMBERS

The following persons have been elected to full membership in the American Scientific Affiliation.

Dennison, A. Dudley, Jr., 7910 Windcombe Blvd., Indianapolis, Indiana, is a self-employed physician specializing in Cardiovascular Diseases. He has earned a B.A. degree from Hamilton College and his M.D. from Cornell University Medical College.

Dowdell, Howard F., c/o Sudan Interior Mission, 405 Huron Street, Toronto, Ontario, Canada, is Education Secretary for the Sudan Interior Mission. He holds a B.A.Sc in Mechanical Engineering from the University of Toronto and an Ed.M. degree from Harvard in Education-Science.

Gish, Duane T., 1955 Peggy Drive, Pleasant Hill, California, is employed by the University of California, Virus Laboratory, Berkeley, California, as Assistant Research Biochemist. He received the B.S. degree from U.C.L.A. in Chemistry and his Ph.D. degree from the University of California at Berkeley in Biochemistry.

Givler, Charles A., 1815 Kenwood Street, North Sacramento 15, California, is an Assistant Hydraulic Engineer with the Department of Water Resources, State of California. He has earned a B.S. degree in Civil Engineering from Pennsylvania State University, and a S.M. degree from Massachusetts Institute of Technology in Civil Engineering.

Hirschy, Philip W., R.F.D. 2, Evans City, Pennsylvania, is a science teacher with the Southwest Butler County Joint Schools. He holds a B.S. in Mathematics from Geneva College, M.Ed. from the University of Pittsburgh and a M.S. degree in Science from the University of Pennsylvania.

Larson, S. Daryl, R.F.D. 8, Box 1034, Springfield, Missouri, is Associate Professor of Chemistry at Evangel College, Springfield, Missouri. He holds a B.S. degree in Chemistry from the State College of Washington and M.S. and Ph.D. degrees from the University of Ilinois in Physical Chemistry.

Roth, Ariel A., 45 Parkway Drive, Berrien Springs, Michigan, is Professor of Biology at Emmanuel Missionary College. He holds B.A., M.S. and Ph.D. degrees in Biology and Zoology.

Schifreen, Clement S., 728 E. Phil-Ellena St,. Philadelphia 19, Pennsylvania, is Cable and Insulation Research Engineer with the Philadelphia Electric Company. He holds the following degrees: E.E. from Lehigh University, L.L.B. from Temple University and Dip. Electronics from Drexel Institute of Technology.

Sherman, Robert H., 510 Knox Avenue, Anniston, Alabama, is a Mechanical Engineer for Post Engineer Office, Fort McClellan, Alabama. He holds a B.S. degree from Michigan College of Mining and Technology in Civil Engineering.

Taylor, William L., 108 Beach Street, Wollaston, Massachusetts, is Assistant Professor of Chemistry at Eastern Nazarene College. He has earned an A.B. degree in Chemistry from Bethany-Peniel College and a Ph.D. degree from the University of Kansas in Chemistry.

The following persons have been elected to associate membership in the American Scientific Affiliation.

Allen, Sydney E., Jr., 4236 Locust, Lincoln 6, Nebraska, is Assistant Professor of Religion at Union College, Lincoln, Nebraska. He holds a B.A. degree in Theology and a M.A. degree from Potomac University in Religion.

Bothamiey, Sylvia Z., 2501 West 18th St., Wilmington, Delaware, is a teacher at The Tatnall School Inc., Wilmington, Delaware. She attended Bristol University, England.