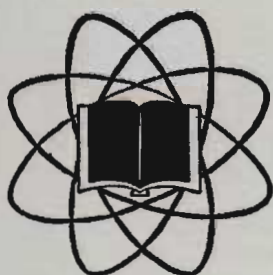


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*The fear of the Lord is the beginning of Wisdom.
Psalm 111:10*

September, 1961

Vol. 13

No. 3

The American Scientific Affiliation

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The Journal of the American Scientific Affiliation

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Vitalism vs. Mechanism from a Biochemical Point of View*

(Introduction to Symposium)

WALTER R. HEARN**

The department of which the author of this paper is a member was formed only a few months ago by bringing together biochemists from the Department of Chemistry and biophysicists formerly in the Department of Physics. When it was decided that the new department should set up a curriculum for undergraduates in biochemistry, the author was asked to write up a brief description of the field and its opportunities, to be used to lure bright high school graduates into majoring in the department. The first draft of this propaganda submitted for criticism began by asking the age-old question, "What is life?" and then pointing out that the scientific answer to this question is the goal of biochemical research. In a paragraph describing some of the outstanding successes of modern biochemistry, this statement was made: "Living things have been found to obey the ordinary laws of physics and chemistry, at least to a very great extent."

Although the material as a whole rated varying degrees of approval among the staff, there was complete disapproval by the entire staff of the use of that qualifying phrase, "at least to a very great extent." The author made a mild attempt to defend the position that at least some of the laws of biological systems are really "extra-ordinary" from the standpoint of physics and chemistry, quoting such physicists as Schrödinger (1) and Elsasser (2) on this point. But the phrase had been inserted in the first place merely to test reactions to it, so there were no hard feelings when it was struck out by unanimous consent.

Perhaps this anecdote serves as a fitting introduction to this paper, which is intended itself to serve as an introduction to our A.S.A. symposium on "Vitalism vs. Mechanism." The point of the anecdote and of the paper is, of course, that the working frame of reference for the modern biochemist is thoroughly mechanistic. Indeed, it may be said without exaggeration that biochemistry is the first fruit of the mechanistic attitude in biology, so it should not be at all surprising that biochemists defend this attitude vigorously or even vehemently.

The names of Rene Descarte, Isaac Newton and William Harvey in the 17th century are often closely associated with the controversy: Newton's, not only because he formulated laws of motion for inanimate bodies and

put mechanics on a firm mathematical foundation, but also because he wrote the *Principia Mathematica* partly as a polemic against the Cartesian system and Descartes' mechanistic philosophy (3); Harvey's, not only because he opened the way for consideration of the body as a living machine by his discovery of the circulation of the blood in man, but also because he leaned toward vitalism, speaking often of life residing in the blood where "the vital principle has its seat." (4). It is easy to see how the great virtuosi of early science came to be quoted in support of both sides of the philosophic question.

In the 19th century it is also fascinating to note that Pasteur's work disproving the claims for spontaneous generation (which had been accepted by Newton and Descartes and presumably Harvey) was published at almost the same time as Darwin's *Origin of Species*, again providing fuel on both sides to keep the controversy hot. But today, half-way through the 20th century, biochemistry is confident of putting genetics, the basis of evolution by natural selection, on a firm molecular basis and is attacking even the problem of the origin of life as a physico-chemical problem (5). The last strongholds of vitalistic thought in science, embryological development and human activity, to be discussed in the other papers of this symposium (6), are themselves about to be shaken by experimental biochemical approaches.

What conclusions can one draw from a look at this philosophical controversy between vitalism and mechanism? To stimulate discussion following the symposium, the author presents the following conclusions, admittedly the highly personal impressions of a Christian biochemist:

1. *From the scientific standpoint, the whole controversy is essentially out of date.*

The arguments usually seem to involve key words like "merely," "only," and "nothing but," and often boil down to arguments over words rather than over meaningful questions. Mechanists often say "man is a machine," or "Life is chemical"; a vitalist will then claim the mechanist has said "man is nothing but a machine," or "life is merely chemical," and proceed to denounce this unmade statement.

Furthermore, the terms "vitalist" and "mechanist" have been used over the centuries for such a wide variety of philosophical positions, that no issues are clarified any longer in philosophical debate by categorizing one's self or one's opponent by these terms.

*Abridged from the paper given at the Symposium on Vitalism vs. Mechanism at the Fifteenth Annual Meeting of the American Scientific Affiliation, Seattle, Washington, August, 1960.

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If, as Christians, we do wish to criticize pseudo-scientific philosophical extrapolations from mechanistic science (such as Julian Huxley's or C. H. Waddington's "evolution ethics") (7), nothing is added to our argument by attacking mechanism itself. For example, when Jan Lever attacks the evolutionary justification of atheism of G. G. Simpson (8), he does it most effectively by showing that Simpson's famous statement, "Man is the result of a purposeless and materialistic process that did not have him in mind. He was not planned" (9) does *not* follow inductively from Simpson's mechanistic science but is a statement of his philosophical "faith."

2. *Scientifically, the two extreme points of view may be regarded as approaching each other in a synthesis under such names as "General Systems Theory."*

At the same time that mechanical explanations of biological phenomena have become better and better, the machines man has produced have become more and more life-like. Indeed, the IBM Company has announced the hiring of biologists for its research teams, to get new ideas for building more complex machines. The only thing that resembles vitalism in current scientific thought is the concept of "holism" or "organicism"

—the idea that a complex system cannot be studied adequately by an analytic procedure which destroys the system, and that therefore the study of systems requires a "system" approach. But the systems involved here may or may not be living organisms, so there is none of the biological exclusiveness of classical vitalism. A symposium with this viewpoint may have papers by biochemists, embryologists, psychologists, statisticians, and electrical engineers, side by side, and the distinction between living organism and machine is again lost. Chapters on "Perception of the Environment," "Learning in Finite Automata," and "Structure of Self-Organizing Systems" deal interchangeably with living and non-living systems (10), so don't let that word "self" fool you! It may refer to an analog computer.

It should be pointed out that if there is a neo-vitalism abroad among working scientists today, it is not the antithesis of mechanism at all, but an attitude which welcomes mechanistic analysis and then tries to go beyond it in speculation after pushing mechanism to its limits (2).

3. *A mechanistic work hypothesis does not necessarily imply a materialistic world-view or total outlook.*

The terms "vitalism" and "machanism" have been used in too many ways to make them useful in denoting precisely specific points of view, but in general the vitalistic attitude is one of over-all synthesis and the mechanistic attitude is one of step-by-step analysis. It seems characteristic for the majority of evangelical Christians to be conditioned toward the synthetic or holistic attitude, and for the majority of modern scien-

tists to be conditioned toward the analytic attitude. The author, being both an evangelical Christian and a biochemist, feels that there is value in *both* points of view and that his own total philosophy must encompass the full utilization of both. That is not to say that when he is doing biochemistry in the lab he will be rigidly mechanistic and when he is worshiping God he will not; rather it means that he will try to think *both* ways about his biochemistry and *both* ways about his faith—in order that he may worship God *in* his daily work and also let this understanding of mechanisms in God's world deepen his understanding of God's purposes revealed in His Word.

If the author seems to put undue stress on the importance of Christians taking mechanism seriously, it is partly because he sees a need to balance the usual stress on non-mechanistic views typical of much Christian writing. The need for balance in our Christian outlook is three-fold:

In the first place, if our Christian faith is to be realistic—if we are to avoid being "so heavenly minded that we are no earthly good"—then we will be continually confronted with problems for which an understanding of mechanism is essential. If we are even to pray intelligently—if our prayer is to be anything more than the mystical absorption into God's being that it is for the Buddhist—then we need all the understanding possible to us of the ways God actually works in nature and in ourselves. To pray intelligently for, or to counsel wisely, someone facing the problem of mental illness, for example, we need every bit of knowledge we can obtain concerning biological and psychological mechanisms.

In the second place, if we seriously intend to witness to non-Christians in a culture oriented toward the scientific method, we must demonstrate a genuine appreciation of analytical thinking. If we do not care to speak the language of modern science, there is little use trying to communicate the Gospel of Jesus Christ to those whose outlook is thoroughly mechanistic. On the other hand, if we can take a mechanistic outlook seriously enough to value it and yet show our non-Christian colleagues its limitations and ultimate barrenness, we can show them that we have all they have and far more in Christ. But if our only answer to analytic questions is some all-encompassing synthesis such as "God is the answer," and we seem satisfied with this answer ourselves, we erect a barrier to communication. Furthermore, lack of understanding or appreciation of mechanism may make the Christian position appear ridiculous (as when a parent lets his child die rather than allow a blood transfusion to be performed, because of the Scriptural statement, "the life is in the blood") (11), and thus seriously hamper our witness to the scientifically-trained.

Finally, at least in its more naive forms, the vitalistic

or anti-mechanistic idea seems inconsistent with Christian theology at its best, which emphasizes that the living God is both immanent and transcendent and that the *entire* created universe—not merely the living, the animal, or the human part of it—is contingent upon His creative and sustaining will. That vitalistic ideas are closely related to religious animism has been pointed out by scientific writers (12). It has also been pointed out by Christians, as in this quotation from a paper read before the Bristol Philosophical Institution more than 130 years ago (13), which makes a fitting note on which to close this introduction:

"The theory of a vital principle has been applied in a different manner, to account for the phenomena displayed at the beginnings of life in animal and vegetable bodies, and to get rid of the mystery which attends the gradual evolution of organic structure from ova and germs. Here the vital principle is no longer considered as a chemical agent, but assumes the character of a plastic or formative

power; it presides over and sets in action the different processes by which growth and organization are effected, gives form and modification to the component parts of the animal or vegetable body, and contributes afterwards, by a preserving influence, to the maintenance of its existence for a definite portion of time. On this doctrine, which has, at the first view, a plausible appearance, we have to remark, that it ascribes to a thing, which on the supposition is merely a species of matter highly attenuated, properties and agencies which belong to the highest power and the highest intelligence. We may, if we choose to do so, term the cause which governs organization and vital existence a plastic principle, but it is a principle endowed with intelligence and design; it is the *same principle*, and *one* and the *same agent* in all created bodies, since all are formed on similar and harmonious laws; it is, in fact, nothing more or less than the energy of the Deity, operating continually through the universe, in preserving and renewing the various tribes of beings, in a manner scarcely less wonderful than at the period when they were first called into existence. To ascribe to a material principle such properties, is to invest it not only with reason and intelligence, *but with the wisdom causes*, cannot be conceived to endow them with its proper attributes. Such language is an abuse of words, and contrary to every maxim of philosophy."

References

1. E. Schrödinger, *What is Life? & Other Scientific Essays*. Doubleday-Anchor Books, Garden City, New York, 1956, pp. 67-83.
2. W. M. Elsasser, *The Physical Foundation of Biology*. Pergamon Press, New York, 1958; pp. 1-19.
F. G. Hopkins, *Problems of Specificity in Biochemical Catalysis*. Oxford University Press, London, 1931.
W. S. Beck, *Modern Science and the Nature of Life*. Harcourt, Brace and Company, New York, 1957.
L. R. Wheeler, *Vitalism: Its History and Validity*. H. F. & G. Witherby, Ltd., London, 1939.
3. A. C. Crombie, *Medieval and Early Modern Science*. Doubleday Anchor Books, Garden City, New York, 1959; Vol. II, p. 164.
4. W. S. Beck, *op. cit.*, p. 61.
5. W. R. Hearn and R. A. Hendry, "The Origin of Life," in R. L. Mixter, Ed., *Evolution and Christian Thought Today*. Wm. B. Eerdmans Publishing Co., Grand Rapids, Michigan; Ch. 3.
6. R. C. Frost, *Vitalism and Embryology*; J. C. Sinclair, *The Mind-Brain Problem*.
7. For an excellent criticism see D. D. Raphael, "Darwinism and Ethics," in S. A. Barnett, Ed., *A Century of Darwin*. Harvard University Press, Cambridge, Mass., 1958; Ch. 15.
8. J. Lever, *Creation and Evolution*, transl. from the Dutch by P. G. Berkout, Grand Rapids International Publications, Grand Rapids, Michigan, 1958; p. 205.
9. G. G. Simpson, *The Meaning of Evolution*. Mentor, New American Library, New York, 1951; p. 179.
10. M. C. Yovits and S. Cameron, Eds., *Self-Organizing Systems*. Pergamon Press, New York, 1960.
L. von Bertalanffy, *Problems of Life*, 1952. Harper Torchbooks, Harper & Brothers, New York, 1960.
11. Des Moines Register news story, February 2, 1960. The incident reported took place in Canoga Park, California.
12. H. J. Muller, "Life," *Science* 121, 1-9 (1955); p. 1.
13. J. C. Prichard, *A Review of the Doctrine of a Vital Principle, as Maintained by Some Writers of Physiology, with Observations on the Causes of Physical & Animal Life*. John and Arthur Arch, London, 1829; pp. 122-123.

Vitalism and Developmental Biology

ROBERT C. FROST**

I. Introduction

The recent advances in biochemical genetics is certain to intensify investigation into the chemical basis of development. Experimental embryology has already embraced a biochemical approach and a wedding of the two disciplines at this level is to be expected. The subordinate mechanisms of gene control as they apply to developmental regulation will provide the common ground for this convergence of interest. Science has been notably successful in its mechanistic approach to life processes, and further fundamental breakthroughs in these areas are anticipated in the near future.

Superficially it would certainly appear that the grave of vitalism is more securely sealed with each advancing step that science takes. Yet, to the Christian man of science who is committed to a theistic world view, is the issue as lifeless as one would be led to believe?

Mechanistic philosophy claims that when all physical and chemical phenomena in living matter can be accounted for, no other phenomena will remain. The dogmatic mechanist would predict that all aspects of life

at all levels will ultimately be explained entirely in terms of natural law. On the other hand, vitalism is a doctrine of the supernatural. The dogmatic vitalist would maintain that the development and integrity of living organisms in their wholeness is dependent upon an inexplicable life force or vital principle which is beyond physico-chemical analysis.

In the history of biology, vitalism and mechanism have alternated with each other for the last three hundred years. Currently the majority of biologists would consider the controversy as relatively quiescent, largely, because, during the last century, mechanists have been signally successful in interpreting natural events, while the vitalists have been signally unsuccessful. The last vitalist of note in biology was the embryologist-philosopher Hans Driesch. He died in 1941. Embryology has been, and still is for a minority, one of the last strongholds for vitalism. Developmental biology still raises some thought provoking questions and, therefore, is worthy of attention as we endeavor to capture additional insights into the problem as we face it today.

II. The Perspective of Developmental Biology

The extraordinary fact that an egg with little visible organization can develop into an organism with a vast amount of organization has in the past intrigued both the scientist and the philosopher. Herein resides a mystery which has no parallel in other areas of scientific endeavor. The reproductive cell does not yet possess any of the features of the adult. Yet in its allotted time, development will progress relentlessly toward a wholeness perfect in size, shape, form and function. Normally, as the embryologist Paul Weiss states it, there is no over-development, underdevelopment or probing excursions along the way.

The perfection of wholeness towards which development is directed is not restricted only to the embryonic egg cell. The capacities for regeneration of lost or damaged parts may be most remarkable. We are familiar with this at the cellular and tissue level during the healing process of cut fingers and broken bones. One wonders why the restorative processes normally cease only when repair is complete?

Regeneration processes in the amphibia are highly developed and most intriguing. An excellent example was

an experiment performed under the direction of Dr. Charles Thornton of Kenyon College. Both forearms of a salamander larva were amputated; one above the elbow, the other below. The wounds healed; cellular and tissue differentiation occurred from relatively undifferentiated cells adjacent to the cut surface. Within a month both limbs had completely regenerated and were functional. Again, one wonders what triggered the regenerative process? How is the particular pattern for wholeness achieved without overshooting or undershooting?

Another example of directed development toward wholeness is seen in the reaggregation of isolated cells from sponges. If a small sponge is forced through the meshwork of bolting silk the entire organization of the sponge is broken up and its tissues are reduced to isolated cells of a variety of types. These cells begin crawling about and forming small aggregates which then organize themselves into new sponges. Each cell type sorts itself out and assumes its proper position to the whole in keeping with its specific properties. The whole process up to the opening of a new osculum takes about three weeks. What are these mechanisms of reconstitution which tend to reproduce organismic wholeness?

This pattern for perfect wholeness is also seen at the unicellular level. *Acetabularia* is a unicellular green

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algae. The mature cell consists of a reproductive cap with petal-like members, a long stalk and a root-like process. The nucleus is usually in the root-like process. Its life cycle takes about three years. Each autumn the stalk dries up to be replaced along with the cap from the persistent root-like structure in the spring. Its regenerative powers have also been studied experimentally. Removal of the cap will result in its regeneration. Furthermore, a single piece of stalk is capable of regenerating both a new cap and root-like structure. Even more

fantastic is the fact that this will occur whether the nucleus is present in the regenerating part or not. If it is present, repeated regeneration can occur; if not, the regenerated cell dies in a few months.

The theme of directed development towards wholeness seems to be a general principle which can be found in some degree at all levels of life. How is this developmental control achieved? Will man ever learn how to control these directing forces? To what extent can we fully understand all that is involved?

III. Vitalistic and Mechanistic Explanations of Developmental Control

For the dogmatic vitalist, the integrating and organizational forces which obtain and maintain the wholeness of the living organism do not reside in physiochemical processes, but transcend them. Furthermore, these forces are goal-seeking and goal-directed. In biological development and regeneration the preordained end towards which these forces continuously strive is the wholeness of the organism. Natural processes are subservient to these forces and become the instrumental means by which the developmental goals are achieved. Vitalism then is truly a doctrine of the supernatural. By definition it lies outside of experimental analysis, and rests entirely upon faith. It should be noted, however, that many vitalists have not equated their supernatural force or vital principle with God as we know Him within our theistic framework.

As indicated before, the opposing position is dog-

matic mechanism. According to this view, to paraphrase Weisz, all of the operations of living matter are governed entirely by natural law and consequently are amenable to experimental analysis. Therefore, the directing forces of development must all reside within the developmental system itself, and furthermore, must consist of physical and chemical events only. Preordained developmental goals would be denied. Natural events are considered to take place sequentially. Cause produces effect and effect becomes new causes as the chain of events is automatically and progressively forged, a result of internal self-direction. In this view natural events are permitted, not made; end states are consequences, not foregone conclusions of beginning states. This is pretty much the secular approach to present day biology as it is presented in our standard textbooks. It is thoroughly mechanistic and causalistic.

IV. Some Current Issues Relative to the Controversy

Current successes in biochemical genetics and developmental biology stem from the ability of man to make mechanistic models which seem to explain some of the most basic processes of reproduction, inheritance and development. A notable landmark in this regard is the Watson-Crick Model for the deoxyribonucleic acid (DNA) molecule. DNA is the nuclear material which contains in chemically coded form all the heredity information necessary for development. Many feel that this advance is the stepping stone not only to a mechanistic explanation of development, but of the origin of life itself. It is interesting to note that a few years ago these areas were considered to be completely beyond the scope of the biological sciences.

A more startling implication has recently received attention in the lay press. Doty and Marmur, two Harvard biochemists, have recently succeeded apparently in unraveling the two strands of DNA molecules and substituting strands from other bacterial species. Through the subsequent process of bacterial transformation they have obtained hybrids. *Time Magazine* observes that such tinkering with life has frightening possibilities, for

there is no reason why chemical hybridization cannot be applied to higher organisms, the highest of which is man. If man is the product of his genes and his environment and learns how to alter both, to what extent in the future will he be able to control and determine the finished product?

At this juncture it would be wise, however, to divorce our tendency to speculate, from the evidence at hand. Life has not yet been produced in the laboratory. We cannot rule out the possibility that it may be far more complex than anything that man can completely analyze and duplicate. Also, although man can already alter his genetic make-up, he cannot yet control the genetic alterations and their developmental consequences. Here again the matter may be almost infinitely complex. The more we learn, the more we find there is to learn. This is a process that is not too surprising to the theist who sees life, indeed all creation, as an expression of an infinite God. Nevertheless, the tremendous gains that have been made thus far in our understanding of basic life processes rest securely on the mechanistic basis of our scientific method, and future gains of major significance are predicted.

V. The Position of the Christian Biologist

The question may now be raised relative to the position of the Christian man of science as he faces the problems of life and developmental control. Must he be a dogmatic vitalist or mechanist, or is there an alternative position which contains elements of both in their proper reference; a position which has sharply defined boundaries in some aspects, but a degree of flexibility in other areas where a measure of reservation would be in order. We shall want to explore this possibility further.

First of all, in what sense is the Christian biologist a mechanist? The answer is obvious. He must by definition be a thorough going mechanist in an operational sense. He is dedicated to the task of knowing as much of the unknown as can be realized by the scientific method. He is not committed to the thesis, however, that biological life and its development can ultimately be reduced to a scientific expression, although the possibility in a limited sense is not completely excluded either. And, he most certainly is not committed to the conviction that all of reality is amenable to scientific analysis. The realm of science has limitations. It has nothing to say concerning values, moral meaning, purpose, beauty, love, liberty, justice or ultimate truth. These realities are all outside the boundaries of science. It becomes clear, therefore, that the Christian biologist is committed to the mechanistic view in an operational sense only.

What then is his relationship to the principles of vitalism? Vitalism has been characterized as a doctrine of the supernatural. Its context, however, is limited merely to the processes of biological life. The Christian biologist, if he is to be true to the theistic emphasis of Scripture, would demand a much greater dimension for his supernatural views.

His God is a supernatural God.

He enjoys a relationship with Him which is a supernatural relationship. Moreover, he is committed to the Scriptural thesis that his God created in a supernatural way the order of nature. Herein we see His Transcendence. His God, has even a greater dimension than just that of the first or primary cause or link in a subsequent chain of natural events. Such a restricted view borders on Deism. The God of Scripture not only created natural law and its modes of expression, but actively supports, sustains and directs its operation for His own ends and purposes. In other words nature becomes instrumental in the hand of God for His divine pleasure. The order of nature as we now know it had a beginning and according to Scripture will some day have an ending. The reality behind it will continue on.

The Christian man of science has a God which is even greater than this, for He is also the author and finisher of moral and spiritual law as well. He is truly the Alpha and Omega, the world Ground to all of creation in all of its dimensions. It is only in Him that nature takes on real meaning and purpose. God has chosen the setting of nature which includes man to express eternal values. We need only to look to Jesus Christ for a clear and concrete example.

Within this world view every new discovery in science gives to us added understanding into another dimension of God's greatness. As our appreciation of God's greatness increases, so should our understanding of His grace. God's greatness always accents that great gulf that separates a man from His God. It was the Grace of God which spanned this gulf. What greater and nobler incentive could the Christian investigator desire for his scientific endeavors? Such Christian conviction should intensely stimulate any Christian student who is interested in the mysteries of science.

VI. Conclusion

We would conclude, therefore, that the Christian biologist is neither a dogmatic mechanist nor a vague vitalist in the extreme sense in which the terms have sometimes been employed in the past. True, he is a mechanist in an operational sense, as he applies the scientific method to nature, but even such endeavors take on a vital spiritual dimension as they are integrated into his theistic world view of life. In this, his view of the supernatural differs sharply from that of the vitalist who limits his doctrine of the supernatural to the phenomena of life. The Christian man of science recognizes that natural law as it applies both to the animate and inanimate has a supernatural basis in its origin and in its perpetuation. Our sovereign and omnipotent God is both the creator and the sustainer of the universe for His own purposes. Herein we see both His transcendence to, and immanence in, the realm of nature.

Within such a perspective, the question whether biological life and its development do or do not supersede physico-chemical laws is of secondary importance. The possibility that many phenomena of life will yield to scientific analysis is beyond doubt. That life at some simple level will be produced in the laboratory, or that the mysteries of directed development will be solved, are still open questions. But, these are questions that the Christian biologist views with anticipation, not apprehension. In fact, as science challenges the mysteries of biological life and its development, the Christian biologist can participate with genuine enthusiasm, intently awaiting any major break-throughs that may lie ahead. For he realizes that each new discovery will be but a further revelation that our sovereign God has graciously given us of Himself.

The Mind-Brain Problem

JOHN C. SINCLAIR**

There are two schools of thought regarding what our attitude toward areas of ignorance should be. The question of how our minds are related to the brain is one such area. One school of thinkers believes that when all the facts are known we will be able to explain how the mind works in terms of the anatomy and physiology of the brain. They do not have such an explanation yet, but are satisfied to wait for new knowledge, confident that when it comes it will confirm their belief just as past discoveries have. As one person expresses it, "In the past the more we have learned the more we have been able to explain, so we believe that we could explain it all if we knew enough." Dr. F. Bremer¹ says, "The physiologist who is faced with the problem of nervous integration hopes that eventually an illuminating synthesis will emerge from the experimental findings which he accumulates. Aware of the sterility of vitalistic evasions, he is a mechanist without illusions. By an act of deterministic faith, he accepts the theoretical possibility that all behavior may be explained in terms of the physicochemical activities of the neuronal network, the structure of which, infinitely complex though it be, appears to be decipherable."

The second school intuitively feels that our minds can manipulate nervous processes, just the way we are able to manipulate the objects of our environment, in creating things for a purpose. They are not willing to deny the existence of a mind which plays upon the brain the way a pianist plays a piano, just because science knows of no way of measuring this control. Our common experience of being able to initiate, direct or inhibit specific acts, or thoughts convinces us of such a control.

Mind, then, is *my* subjective awareness of how I think and act. It is the pattern of activity of the constituent parts of *my* brain, my bone encased central nervous system. When this "*pattern*" of activity is interrupted in one way or another, mind ceases to exist. Mind is not the activity of the cerebral cortex *per se*, such as an alpha sleep rhythm, but an asynchronous "*pattern*" of activity.

From a physiological point of view the nervous system is organized on a reflex basis. The simple monosynaptic stretch reflex is an example of this. The sudden stretch of a muscle by striking its tendon, activates sensory receptors in the muscle. These receptors respond by sending a burst of nerve impulses along its axon to the cell body in the dorsal-root ganglion of the spinal

cord, and into synaptic endings on the surface of the motor-horn cells of the same muscle. Through the release of a neurotransmitter, the motor cell membrane is depolarized to the level at which it, in turn, initiates a spike potential which propagates along its motor axon to the nerve-muscle junctions within the muscle. This electrical disturbance releases acetyl-choline which activates the muscle membrane to trigger the myofibrils to shorten.

This reflex arc is anatomically built-in and it can be mapped out by suitable staining methods. Physiologically, however, it is complex. Both excitatory and inhibitory influences play upon the motor-horn cell. The fine muscular coordination of which we are capable is achieved by the frequency of firing and time of firing of individual motor cells. In this simple example, the contraction of the muscle is an appropriate response to the stretch of its sensory receptors.

In Pavlov's experiments, the secretion of saliva by his dogs, when a bell was sounded which previously was associated with the sight and smell of food, is an appropriate conditioned response. It readies the animal to chew and swallow the anticipated food. By such responses the brain enables the animal to maintain and reproduce itself within its environment.

On a trip north, I stopped to visit friends whom I had not seen or heard of for years. It was amazing how the familiar faces and places brought back memories that were otherwise forever lost to me. We can speak of this type of memory as "cue" dependent, for a sensory cue is needed to trigger it. Memory is an appropriate response to environmental "cues."

Sensory deprivation studies on normal students demonstrate how essential environmental stimuli are, in maintaining the integrity and activity of the mind.² Sensory feed-back from proprioceptors activated by the responses we make enables us to monitor the appropriateness of our movements. Feed-back from our ears monitors our speech, and feed-back from our audience monitors our interpersonal behavior.

If mental functions can thus be described on a reflex basis, what does this imply relative to our subjective experience of freedom of choice and purpose? Let me suggest that the directing of thought rather than thought itself is peculiar to Mind. By directing our attention or changing our position we can limit the environmental stimuli to which we make a response, though we can not determine whether we will respond or not. What this might mean physiologically, is that I can only acti-

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vate neurons through presently active ones, so that no immaterial force or entity can *initiate* mental activity. My mind is thus inextricably bound to the functional integration of the cells of my brain. This seeming paradox can be considered in a logical way also. My world view is a mental one. It is a projection of the sensory cues travelling in from my receptors. According to this point of view it is impossible to be both object and observer³. We automatically exclude the observer, our minds, when we study nature objectively.

The idea has been expressed⁴ that the principle of indeterminacy allows for freedom of will, that we can not say, "behavior is causally determined," because it is not possible to experimentally establish the causal basis for it. I personally do not see how someone's knowledge of the laws of human behavior and a knowledge of my past behavior can prejudice the choice I make of an appropriate response to a given situation, unless perhaps I knew what he predicted and why. Even God's knowledge of what I am going to do does not deny me the freedom to do as I please, unless I voluntarily submit my will to His. Pharoah of ancient Egypt was not coerced by God to oppose the escape of Israel.

Conclusion

We have found in physics that there is a complementarity between our knowledge of matter as waves and as particles. Likewise, our knowledge of the behavior of the functional organism complements our knowledge of the chemical and physical processes associated with this behavior. So also, our subjective experience of nature as observers complements what we know of the physiology of nerve nets and of the behavior of other organisms. I conclude, therefore, that the ultimate reality of matter is not wholly explicable in terms of the behavior of individual quantal particles; that the phenomenon of life is not wholly explicable in terms of chemistry and physics; and that Mind is not wholly explicable in terms

He did it because he wanted to. God just made His plans for the plagues according to Pharoah's own freedom of choice in this matter.

The question of feed-back information which concerns the effectiveness of what we do in terms of why we do it, and the critical importance of the constant barrage of sensory stimuli, of which we are almost totally unaware, have scarcely been mentioned. The Moody Science Film, "Sense Perception," pointed out the inexplicable, though compelling mental reaction that one experiences when the sensory homestasis to which he is accustomed is altered too drastically. The questions of memory, consciousness, the unconscious, and the interplay of heredity and environment have likewise been slighted. For these reasons I do not believe I can adequately convey my awareness of the extent of my personal freedom within my material, biological and spiritual frame of reference, nor indicate the critical areas where God and Faith in God can play a decisive role in determining how I think and feel. Perhaps all I can hope to do is to communicate an inquisitive, uncertain, tentative and critical attitude toward these matters.

of the behavior of nerve cells and their interactions. In physics we are dealing with statistical patterns of distribution of quanta, in life with spacio-temporal patterns of chemical and physical processes, and in psychology with patterns of nervous activity. What maintains these patterns? Does God play dice, asks Einstein, in determining the behavior of individual quanta? Is there a vital principle that maintains life? Is there an immortal soul that weaves patterns of nervous activity? Science can not say, for no experiment can be designed to test these postulates without destroying the phenomena in question.

BIBLIOGRAPHY

- ¹Bremer, F., *Handbook of Physiology*, Sec. 1, Vol. II, 1241 (1960)
- ²Hebb, D. O., *Am. Psychologist* 13, 109 (1958)
- ³Schrödinger, E., *Mind and Matter*, Cambridge Press, 1958.
- ⁴Eccles, J. C., *The Neurophysiological Basis of Mind*, Oxford Press, 1953.

*The Relevance of Scientific Thought to Scriptural Interpretation**

G. DOUGLAS YOUNG**

In what way can an appeal be made to science and its conclusions to help us interpret the Scriptures? How can scientific information, i.e., information from the world of science, aid in the interpretation of Scripture?

I see no way to address myself *directly* to this question. Some attention to definitions and/or presuppositions is first required. It would not be proper here to present an apologetic for a view of Scripture. But it is necessary to have in mind clearly what our view of Scripture is—our view of its authority—the Scripture about which we are concerned to find the relevance of science as an aid to interpretation.

Is this Scripture a pre-scientific document, with all the implications that this usually implies? Since it was written long before the modern world of scientific knowledge, are we at liberty to reject what it says about scientific things if that does not square with our modern scientific knowledge? No, by no means. If we give some thought to how it was written we can quickly see that that is not the way out for us.

It is not the state of knowledge of the human authors of the Bible that is here significant. How they acquired the information they subsequently recorded is not germane to our discussion. They were, perhaps, unlearned and ignorant men, judged by our standards doubtlessly so. It is irrelevant that the authors were living in a pre-scientific age and that they could have had no knowledge comparable to what we have today. How they acquired their information is not relevant to this discussion. This, the acquisition of information by the writers of Scripture, the theologians call revelation. It is distinct from inspiration, which has to do with the communication of information.

Inspiration, as it refers to Scripture, we define as a supernatural act of God the Holy Ghost on the writers of our Sacred Books by which influence their words were rendered also the words of God, and therefore free from any error of doctrine, fact or judgment.

It really does not matter what scientific knowledge the human authors had in detail. It matters that God supernaturally moved with and upon them as they wrote so that their words were also His. The sacred writers were guided in their writing in such a way that while their humanity was not superseded it was yet so dominated that their words became at the same time the words of God, and thus infallible.

This has been through the centuries and continues to be today the formulation of the church on what the Scripture is. We do not, therefore, escape the problem by blaming the ignorance of the human authors and then using modern scientific conclusions as the norm by which we interpret their words.

We shall not here enter into the problems of canon (what books) or textual criticism (which variants in the texts and which texts) or where are the autographs? Thousands of effective pages have been written on all of these points. Nor shall we go into the alleged charge of dictation or the mechanistic theory of inspiration; namely, that our view of the Bible must make man a mere robot of God in the reception of information. This is no new battle, nor are the charges new. Dr. J. G. Machen, writing in 1923 in his classic *Christianity and Liberalism*, referred to all of them.

Certainly that is a stupendous claim, and it is no wonder that it has been attacked. But the trouble is that the attack is not always fair. If the liberal preacher objected to the doctrine of plenary inspiration on the ground that as a matter of fact there are errors in the Bible, he might be right and he might be wrong, but at any rate the discussion would be conducted on the proper ground. But too often the preacher desires to avoid the delicate question of errors in the Bible—a question which might give offence to the rank and file—and prefers to speak merely against "mechanical" theories of inspiration, the theory of "dictation," the "superstitious use of the Bible as a talisman," or the like.

Our view of inspiration is a basic campaign. It *is* an assumption. But it is *precisely* this which we must assume before we can take the words of the Bible as any basis of authority, and hence worthy of our taking time to bring science to bear on their interpretation. Any other view introduces the subjectivism of the human mind as the norm.

It does not weaken our case to state that it rests on assumption. The opposite rests on assumption too. Nor is this a new idea. In 1878, A. A. Hodge put it this way:

Now, it is held, on the basis of all the presuppositions of Atheism, of Materialism, of Agnosticism, and even of the old Deism, that it is absolutely absurd to talk of any supernatural revelation of God, or of any Bible as either *containing* or *being* the Word of God. I want, however, to assure the laymen who have not investigated these questions that nine-tenths of all the objections which men are making now to the Scriptures, in which they claim that the progress of knowledge, the progress of

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civilization, the progress of science, the progress of critical investigation, the vast aggregate of historical knowledge, all are sweeping away the foundations of our ancient faith in the Bible,—I wish to assure them that these objections are not only untrue, but absurd. Those that are made are not founded upon *a priori* philosophical principles. Neither science nor history nor criticism bears any testimony against the divine origin of the Bible. I appeal with confidence to the *a priori* principles of a contrary philosophy. We must meet them on their own ground, and appeal from the postulates of a false philosophy to the postulates of a true. We have as much right to believe our philosophy as they have to believe theirs. Renan, for instance, begins his discussion upon the Epistles with this assumption: "The supernatural is impossible;" therefore the supernatural is unhistorical, and therefore any piece of literature that claims to convey to us supernatural information must so far forth be incorrect and be the subject of correction by critical hands.

You see that this is a mere assumption, and the whole principle on which it rests is that which underlies the philosophy, atheistic, materialistic, agnostic or deistic, of these errorists; and if this be swept away not only all the foundations for such a claim, but all color of presumption on which it rests, is swept away at once. Doubtless there are very many men of great ability who are perfectly honest who hold to this belief. They are thoroughly convinced of the principles of their *a priori* philosophy, and these principles are evidently inconsistent with the truths of Christianity.

But if we discard the unproved assumptions, we invalidate their conclusions . . . (*Popular Lectures on Theological Themes*, Lecture IV.)

That is our view of Scripture. It has God's authority for its words. But, we must interpret these words of men, these words of God too. What canons of interpretation can we use? The most basic is that we must interpret them literally. Ramm defines the literal meaning of a word as the customary, socially acknowledged designation of that word. A more classic, if less obscure, definition would be that we must use the grammatico-historical-theological interpretation.

This is to take the words at their customary, socially acknowledged designation—the literal meaning. What did those words mean in those days? What did they designate to the authors? *This is what is most basic.* It is not critical what they mean in translation today in our society. What did they mean then in the society of the authors?

If this be true, then archaeology, history, philology and linguistics are the important interpretative tools—the determining criteria—and not modern science.

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What is the role, or relevance, of scientific thought to Scriptural interpretation? *It ought to stir up our minds, but it can not be the norm. It may give us a key, but it is not the final authority.* The final authority must, by definition, be the meaning of the words as interpreted in their culture.

Does this not bring us to an impasse, the same old blind alley where science is pitted against the Scriptures? If science could be a norm, and we could interpret the Scripture by it with certainty, things would be so much easier—in every age—but in which age would we finally have the right interpretation? I can not answer these questions. But I do have a practical suggestion which I feel is important. It is this: wherever there is a difference for Christians* between what science appears to say and what the Scriptures appear to say, since God is both the author of the physical World and the Word and therefore these two documents must be presumed to be complementary the one to the other, we cannot be sure which is correct, the Bible as interpreted in and by the light of twentieth-century science and culture, or our present understanding of science, or neither. We do not have the right to insist upon a final conclusion on such a point of difference until we can find the rationale between the two. This works both ways—for biblical interpretation and for scientific interpretation.

Let me illustrate the first, interpreting the Bible by 20th century meanings of words:

Genesis 2:7 " . . . the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul."

Evolutionary theorists would have God make man out of an already animate brute by imparting the spirit to him at a given point in the brute's evolutionary development. Millions of years likely intervened between the dust stage and the body-like-man's stage. Then this brute became man by God's inbreathing. However, this interpretation can not stand. The Hebrew behind "a living soul" in Genesis 2:7 is *nephesh hayab*. The same words are found in Genesis 1:21 and 1:24. There they are translated "living creature." The words mean "animate" or "alive." He created everything that has life. " . . . and God created great whales, and every *living creature*" (Genesis 1:21). This form made from dust, then, was not animate. It had no life prior to God's breathing *nephesh hayab* into it. It was at this point that the inanimate clay became alive. It was not at this point that an already animate body became a man by the infusion of "spirit."

*We cannot dispute the Virgin Birth of Christ, or the physical resurrection of Christ, or other items commonly accepted by Christians, in common agreement, as cardinal to Christianity. The differences referred to in the body of the article are differences in areas not of general agreement as between Christian men of science and Christian theologians. Obviously there will be debatable points as to which items are in this category and which are not. The principle enumerated is a "rule of thumb."

Thus modern usage of words can mislead us. And, if the idea is scientific that before he became man "man" was a living brute, and if we must therefore use this "scientific" idea to interpret this passage of the Bible, (as some are doing), science leads to an incorrect interpretation. The interpretation that we must accept comes from philology, not science, in this case.

Finally, let me illustrate what I mean by the rationale of two complementary items.

Ephesians 4:8 states that Christ gave gifts to men. It is a quotation from Psalm 68:18 which states that He received gifts for men (at least in our English translations). How can it be that He gave gifts and received gifts both at the same time? Which testament is correct? The usual answer is "The New Testament is later and it is correct." No. Is there no rationale or must we force

one on the other? Using Ugric philology again, the Psalm may read "He received gifts from men," that is, from among men He received men. The gifts were men. Now the rationale is clear. The psalmist speaks of his taking gifts, namely, of capturing men. The apostle speaks of giving these gifts—giving these gifted men to men for the work of the ministry, some as apostles, some as evangelists, et cetera. The two complement each other, as we would like to hope, and therefore we can reasonably believe that we have a "true" interpretation of both passages.

So it should be with an interpretation of the Word and of the physical World, the one should complement the other, each should help to interpret the other, and we should be wary of forcing either by the other.

The Relevance of Scriptural Interpretation to Scientific Thought*

JAMES D. BALES**

There are those who maintain that Scripture and Science move in two entirely different realms and therefore there can be no relevancy between the two. There can be no conflict for never the twain shall meet.

The author believes that there is some relationship between scriptural interpretation and scientific thought. The Bible does have a bearing on science.

We do find points of harmony and points of conflict between science and Scripture. It seems to me that it is inevitable that the historical revelation, and its view of man's nature and needs, should come into contact with various sciences.

If the peoples of the Bible really lived, then whenever their remains are located by the archaeologists, the Bible and the archaeologists are both dealing with at least some aspects of the same subject—although one may furnish some information which the other does not.

When a scientist studies man as a material being, to see how much can be learned on that plane, this is one thing. However, if he maintains that this is the whole story about man and that science proves that it is, immediately there is conflict between that science and Scripture.

When man is studied as an animal in order to learn all about man that can be learned about him as an animated physical body, the Scripture does not stand in his way. If he maintains that science shows that man is just an animal, conflict is introduced. The Biblical interpretation of man has priority for the believer, although the believer recognizes that the Bible does not tell us all there is to know about man, and thus we should learn from any source what it can teach us about man.

When so-called scientific socialism, as held by Marxists, maintains that there is no basic human nature, but only a reflection of a temporary economic system which will give way to another system, it comes into conflict with the Bible.

It seems to me, therefore, that to maintain that there is no relevancy is to imply that the Bible does not deal at all with the physical world, that it is unrelated to history and to human nature and that it is just a system of ideas which are unrelated to the world of reality with which science deals.

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The Bible Is Not Anti-Intellectual

The relationship is not, as some on both sides have assumed, one of necessary antagonism. There may be believers who are against science, and scientists who are against the Bible, but it does not follow that of necessity irreconcilable antagonism exists. The Bible is not anti-intellectual and thus it is not anti-science.

The Christian should love God with all of his *mind* as well as with the rest of his being (Matt. 22:37). He also has a broad curriculum on which to *think* (Phil. 4:8).

The intellect is appealed to in the presentation of grounds for faith. In Acts 2, four lines of evidence were advanced. (a) Jesus' miracles (Acts 2:22) (b) Prophecy's fulfillment (Acts 2:16, 17, 25-28, 30, 34-35) (c) The resurrection (Acts 2:32) (d) Miracles on Pentecost—something seen, heard and done (Acts 2:33, 2, 3, 4, 6, 8, 11). On the basis of these lines of evidence faith was called for. "Therefore let all the house of Israel know assuredly, that God hath made that same Jesus, whom ye have crucified, both Lord and Christ" (Acts 2:36).

Not only do the credentials of Christ make an appeal to the intellect, but the intellect is involved in understanding the Bible and in applying its principles.

The condemnation of human wisdom in 1 Cor. 1 and 2 is not of the intellect but of man's arrogant determination to understand God, man, duty, life and destiny apart from—in fact, in repudiation of—divine revelation.

The author believes that the type of mind which the Scriptures teach is essential for faith in Christ is the type which is essential in discovering and understanding truth in any realm. (a) Willingness to hear the evidence, without being swayed by passion and prejudice (Matt. 13:14-16; 2 Tim. 4:2-4) (b) Humility which leads us to be teachable (Matt. 18:1-4) (c) Love of truth (John 18:37; cp. 7:17; 2 Thess. 2:10-12) (d) Good and honest heart which furnishes receptive soil for seeds of truth (Lk. 8:15).

As far as the author can see there is no field of scientific research into which the Christian cannot enter, unless it involved transgression of moral law.

The Scriptures Furnish a Magna Charta for the Scientist

There are principles in the Bible which furnish a Magna Charta, so to speak, for the scientist. Regardless

of whether or not an individual derives these from the Bible, they are also found in the Bible.

(1) Man's dominion (Gen. 1:26-28). This is not passive, for man is to subdue the earth (Gen. 1:28), and it seems to me that science is involved today in man's subduing of the earth. Even in the Garden he was "to dress it and to keep it" (Gen. 2:15).

(2) The Bible keeps the scientist from becoming so submerged in his materials that he becomes depersonalized and depersonalizes others. Men are more than "personnel units," reacting mechanisms, mere matter in motion, etc. Science cannot completely explain the scientist.

(3) The Biblical view that man is a being with the power of rational thought, one who can weigh evidence, one who can think straight, is essential to science. If atheism, or any brand of materialism, is true, thought is but matter in motion which has been set in motion by previous motions of matter; none of which have been based on a thoughtful evaluation of evidence.

Karl Marx's view was that thought is but a reflection of the material world—of which the economic world is the basic factor—transformed into forms of thought and reflected in the mind. Thus not only would his materialism make rational thought impossible, but so would this view since he maintained that the world in which we now live was based on an irrational economic order (capitalism).

(4) The concept of an orderly, law-abiding universe is an essential concept for science.

Science would be impossible in at least most aspects of an animistic society; in fact, in all aspects if a society was wholly and consistently animistic. How can an orderly universe be postulated, and science possible, if nature is under the control of a wide variety of arbitrary spirits?

Superstitious attitudes keep the superstitious from being scientific in the matters towards which they have a superstitious attitude. For example, a French meteorologist in the Congo was accused by the natives of stealing their good weather and selling it to their enemies. It is difficult enough for the weatherman in the best of surroundings, but how could a science of weather prediction be developed amongst a people who thought that through witchcraft their weather could be stolen and sold to someone else?

How could experimentation on animals be carried out in a society where these animals were worshipped or viewed as the reincarnation of human beings?

It may be objected that the Bible is animistic in that there are cases of demon possession recorded in it. However, the context in the Bible is quite different from the animistic society. In the Bible, demon possession was an unusual thing. Although people were driven crazy

by demons, yet there are cases of lunacy in the Bible which are not attributed to demons. Furthermore, the sticks, stones, trees, etc. were not viewed as under the control of divers spirits. The context in the Bible is that demon possession is seen in the setting of a law-abiding universe, while an animistic society does not view the universe as law-abiding.

The Bible is also a friend of scientific investigation because for scientific investigation to flourish unfettered there must be freedom. And where the Bible is *known*, and *lived*, freedom does flourish.

Experimentation

Does the Bible have any relevancy to scientific experimentation? Yes, in at least two respects. First, with respect to basic attitudes which the Bible inculcates, such as industry and integrity. Second, it would rule out certain areas of experimentation since it affirms the reality of moral and spiritual values and views man as moral and spiritual and not just as a manifestation of matter. Although obviously a new medicine, or a new type of operation, after adequate testing otherwise, has to be tried out on some one, yet the use of human beings as guinea-pigs as Nazi scientists used them is ruled out. "Frequently they even used their victims indiscriminately and irresponsibly, killing hundreds when only a few (horrible as is even this) would have sufficed." (Robert E. D. Clark, *Christian Belief and Science—A Reconciliation and a Partnership*. London: The English Universities Press, Ltd., 1960, pp. 130-131. In a footnote he states: "For a brief summary see A. C. Laennec, *Medical Experimentation and Man*, Eng. trans., 1955, pt. IV").

The Scriptures would also keep man from experimenting with moral and spiritual values. Man should not endeavor to test immorality through personal experimentation. Obviously, he should apply to his own life the moral and spiritual values in the Bible and in so doing he will find them confirmed, in so far as it is possible for them to be, in the crucible of experience.

The Scriptures Can Guard the Scientist Against Certain False Conclusions and It Can Suggest Certain Leads

It seems to me that the Bible does indicate that it would be useless to conduct certain types of investigations. For example, the Bible teaches the unity of the human race in its origin and nature. God created man (Gen. 1:27-28) and "hath made of one blood all nations of men for to dwell on all the face of the earth" (Acts 17:25-26). The basic unity of humanity is implied in the great commission (Mk. 16:15; Matt. 28:18-20). Thus I believe it is futile for a scientist to try to prove otherwise; although when he tries he may find certain things wherein individuals and cultures differ, his research on the whole will point to the unity of the

human race—that it is the *human* race to which we all belong—and he will confirm the Bible in this particular.

A knowledge of the Bible will enable the scientist in certain areas not to draw certain false, and in some cases destructive, conclusions from his data. If Dr. Kinsey had known and respected the Bible, he would not have implied that the fact that many people were doing a thing constituted ethical justification for that type of conduct. He recognized this, at least sufficiently to show that it raised problems, but as Barbara Benson said: “. . . Dr. Kinsey suggests that conflicts arising from sexual adjustment would be fewer if standards more nearly coincided with practice. However, he repeatedly points out that facts of behavior cannot be accepted as the code of behavior without raising other serious problems.” (“What Women Want to Know About the Kinsey Book,” *Ladies' Home Journal*, Sept. 1953, p. 53).

Kinsey's treatment of homosexuality led Dr. Edmund Bergler to write an article on “The Myth of a New National Disease” (*The Psychiatric Quarterly*, Jan. 1948, pp. 66-68), and to take Kinsey to task for attempting “to give homosexuals a clean bill of health” (*Ibid.*, p. 87). Regardless of the findings of investigators, homosexuality can no more be justified than can adultery.

There are some who have combined a misunderstanding of Science with a passage of Scripture and have ended up with a false charge against the Bible. For example, some have said that if woman was made from a rib of man, man should have one less rib than woman! A moment's thought, however, reminds us that such acquired characteristics would not be inherited. If Adam had had his appendix removed it would not mean that his children would be born without appendices.

Although science in its very nature seeks a natural explanation, and one may probe to see how far such an explanation may be pursued, yet the Bible would keep the scientist from concluding that everything can be explained naturally. And it is my understanding that entropy indicates at least that the universe is not a self-contained, self-explained system which can be explained in terms of present day processes. Although the scientist operates on the assumption of uniformity, yet an effort to explain naturally the totality of things breaks down when he postulates that in times past forces which work today produced results which they no longer produce.

The Scriptures kept informed believers from assuming, an assumption which science shows to be false, that the earth was always habitable or that man has forever lived on earth.

The Scriptures also show, what science confirms, that man arrived last. The Christian views man as the crown of creation, and even those evolutionists who hold to atheism regard him as the present crown of evolution.

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Then, too, the Scriptures keep us from expecting a race of supermen on this earth as advanced over man as man is over the ape.

Although the Scriptures do not give us a definition of kind, and thus it does not tell us the exact extent of variation within a kind, yet the fact that it does show that there are boundary lines—for example, between man and the animals—keeps us from assuming that there are no unbridgeable gaps. However, as a scientist a Christian may probe to see to what extent variation may take place—with reference to the fruit fly, for example.

Although the Bible leaves the anthropologist free to investigate the various religious faiths, yet it would have kept him from seeking to prove that the history of religion must fit an evolutionary framework wherein religion evolved from atheism, animism, polytheism, etc. to monotheism. A great deal of energy went into the effort to prove that monotheism was the end product of an evolutionary development. More and more students, however, are concluding today that the evolutionary framework is artificial, and some have concluded—apart from the Bible—that monotheism was first.

The Bible would have kept men from assuming that primitive man was a savage barely out of the animal stage. Furthermore, it would have led them to understand that so-called primitive man in various parts of the world today is not primitive man but fallen man (Rom. 1).

The Scriptures furnish some guidelines which would have kept some psychologists from false and even very destructive theories. It would have kept them from assuming that man is wholly material and that he can therefore live by bread alone. Man needs a meaningful faith, some frame of reference, by which to live. Professor Adam Schaff, head of Warsaw University's Department of Philosophy, and who is on the Central Committee of the Polish Communist Party, said recently that a student asked: “Please don't be angry, but could you explain the meaning of life?” He saw that the student was not just baiting him, that others were concerned, and this jolted him, for up to now he had rejected “such subjects as so much blah-blah.” He admitted that up to now Marxism had not really dealt with this, and that it would need to do so—on a “scientific” basis, of course. (*Time*, June 2, 1961, p. 58).

To take one other example, in the realm of psychology, the Bible in the many motivating appeals which it makes would protect one from taking one motivating appeal and viewing it as the only appeal. It would have kept some psychologists from taking the position, as some once did, that all appeal to fear is wrong. It would keep others from neglecting the appeal to love.

If I were a scientist, I think that I would read through the Bible at times to see if there was anything there that

might furnish some lead for me in my field, or that would keep me from an error in the interpretation of my data.

It might be, and I have not checked this story nor carefully studied the passage to see the meaning of "paths," that they will be stimulated as Matthew Fontaine Maury was when he read Psalms 8:8 about the "paths of the sea," and then finally charted lanes across the Atlantic. ("Pathfinder of the Seas," *Reader's Digest*, July, 1940).

When Conflicts Come

Conflicts between theologians and scientists will take place from time to time. But one of the reasons why the believer will not be upset by the latest hypothesis of some scientist, is that changes, even radical changes, take place in science. We say this not as a condemnation of science; in fact, it is a commendation of the scientist who changes when he sees that his previous hypothesis is inadequate.

It is also helpful, in dealing with points of conflict, or seeming conflict, to realize that the scientist is seeking to find a *natural* explanation. In the very nature of scientific research he searches for natural explanations and not a supernatural one.

In the March, 1958, issue of *The Christian Graduate*, Gordon E. Barnes wrote: "Religion is concerned with significance and purpose, while science is concerned with structure and mechanism. They therefore give different accounts which are not mutually exclusive but complementary, and which, taken together, give a more nearly complete picture of the truth than either alone."

"... Science is concerned with describing *how* things happen and takes no account whatever of *why* they happen." (Warren Weaver, "Science and Faith," *The Christian Century*, Jan. 5, 1955, p. 11). "... I can assure you that Professor Einstein has no slightest idea of *why* gravity operates. Indeed any such question would completely and properly confuse him, for such a question lies wholly outside science." (*Ibid.*, p. 12).

If we are trying to understand nature by finding the answer to why the kettle boils—or rather, what causes the kettle to boil—we do not introduce a personal type of answer and say, Because I want tea. (D. C. Spanner, "The Methods and Limitations of Science," *The Christian Graduate*, March, 1953, pp. 12-).

To bring in God in our scientific explanation is to turn from the materialistic *how* to the personal *why* and *who*.

Furthermore, by bringing in God prematurely to bridge a gap in our scientific knowledge can lead to bad results. "Science breaks through the gaps, and religion seems once again to be in retreat." (*Ibid.*, p. 19).

The Bible May Be Misinterpreted

When a conflict between science and Scripture arises we may also reckon with the fact that it is possible to misunderstand the Bible. Some by misinterpretation of the Bible have tried to make the Bible relevant to science in a matter where it was not relevant. They have brought on unnecessary conflict. One must always be willing to study to be sure that he has not tried to speak for God where God has not spoken for Himself.

What right have we to tell scientists that God does not intend for man to explore space, to go to the moon or to Mars?

A careful study of the case of Jacob, the peeled rods and the flock shows that the Bible is not teaching the theory of maternal impressions (Gen. 30:37-42; 31:1-13. See also John P. Van Hartsma, *The Supplanter Undeceived or Jacob's Divine Instruction in Heredity*. Grand Rapids, Michigan: H. Kuizema and Son, 1941).

Some things in the Bible are left in obscurity. The Bible was not given to make us experts in every field under the sun.

The Scriptures do not always distinguish between God's direct working and His indirect workings, so we must be careful not to conclude that in every place where God is said to do something that it means that it was done immediately, directly, without working through any secondary causes. For example, God sends the sunshine and the rain on the just and on the unjust, but to conclude that no laws of nature are involved would be wrong (Matt. 5:45). It is not an assault on the Bible to maintain that the evidence shows that laws of God are involved.

The Bible attributes the creation of man to God. Was this a direct act of God, or did God do it through laws over a long period of time, so that man in harmony with His laws evolved physically from the animal world?

In my judgment Genesis *One* does not tell us exactly *how* God created man and woman. In fact, we know from Genesis *Two* that Genesis *One* omits the first "stage," as it were, of the creation of woman. Although Genesis 1:26-27 does not say that man and woman were created at the same time, this is the conclusion which some draw from Genesis *One*. If Genesis *One* were the only passage in the Bible on the subject there would be no grounds on which either to affirm or to deny the simultaneous creation of man and woman.

However, Genesis *Two* shows that God created man first from the dust of the earth (Gen. 2:7). We do not know how much later it was that "Jehovah God said, It is not good that man should be alone; I will make him a help meet for him." (Gen. 2:18). In the animal world "for man there was not found to be a help meet for him. And Jehovah God caused a deep sleep to fall upon the man, and he slept; and he took one of his

ribs, and closed up the flesh instead thereof: and the rib, which Jehovah God had taken from the man, made her a woman, and brought her unto the man. And the man said, This is now bone of my bones, and flesh of my flesh: she shall be called Woman, because she was taken out of Man." (Gen. 2:20-23).

This case should teach us that when the Bible leaves a blank we must be careful in assuming that the blank must have been filled in after such and such a manner. It may have been in that manner, or it may not have been. For us to arbitrarily commit the Bible to a specific manner, when it has not committed itself, is to deal unfairly with the Bible and to run the risk of discrediting the Bible in the minds of some people. We may suggest possible manners while clearly indicating that we do not have, from the Bible alone, sufficient grounds on which to definitely decide on a specific manner. If evidence from outside the Bible gives us grounds for deciding the manner, we can accept, and we should accept, this outside evidence without feeling that in any way it has set itself against the Bible.

It will be observed that the Bible does not say *how* God formed man's body from the dust of the earth, nor how *long* it took. However, it does not seem to me that the silence of the Scriptures in this place gives us any grounds, when we consider some other passages, for assuming that it was by an evolutionary process via the animal route.

First, although animal flesh was already in existence—and it, too, was formed of the ground (Gen. 2:19)—yet the passage in Gen. 2:7 does not say that man was formed from animal flesh but of the dust of the ground. Both animal life and dust existed when God created man. God made man from the dust and not from living creatures. This by itself might not show conclusively that animal flesh was not an intermediate step, with the dust of the ground being the original material and the basic material in both animal flesh and human flesh. But it does fit in with the idea of man as a special creation.

Second, Genesis 1:24-25 shows that God created animals and enabled them to bring forth *after their kind*. "And God said, Let the earth bring forth living creatures after their kind, cattle, and creeping things, and beasts of the earth after their kind: and it was so. And God made the beasts of the earth after their kind, and the cattle after their kind, and everything that creepeth upon the earth after its kind: and God saw that it was good" (Gen. 1:24-25). The law of reproduction in this passage reveals that the animals, who were created before man was created, were to reproduce after *their kind*. However, if man came by evolution via the animal route, some animals would have had to produce not their own kind, but mankind. God, if He so willed, could have in some cases made an exception to this law of reproduction but Genesis One and Two neither state nor imply such a tremendous exception.

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Third, the evolutionists—so far as I know—believe that man and woman came by the same route. Even if man had evolved from animals it could not be assumed that woman so evolved, for the Bible expressly says that she was made from man. No evolutionists whom I know of maintain that man evolved and that later from man woman evolved.

Furthermore, if such were the case it would have to be a very speedy evolutionary process in order for woman to evolve, and offspring to be possible, before man died of old age!

Fourth, in Gen. 1:30 animals, birds, and creeping things are referred to as those "wherein there is life," or a living soul. These were living in contrast with the non-living. In Genesis 2:7 "man *became* a living soul." Although man was made in God's image (Gen. 1:26), and is more than an animal, yet he does also have the life of the body. Man is also a living creature. It is important to notice that Gen. 2:7 speaks of the *inanimate becoming the animate* (formed of the dust, the breath of life breathed into his nostrils "and man became a living soul"). In other words, man was not alive as a beast and then became alive as a man. He was not alive in brute form, and then developed into a human form. Instead, he became alive.

The Scriptures as the Authority for the Believer

When the Bible sets forth a position we must accept it, regardless of the current attitude of some scientists. Although we should be willing, if the evidence indicates that such a re-examination is called for, to re-examine our interpretation of the Bible, we should never approach it from the standpoint that the Bible must harmonize with some idea which is current in some section of the scientific world. The word of God must take priority over the words of men—whether scientists or not. We should not be appeasers who hastily seek to harmonize the Bible with the latest hypothesis.

On the other hand, humility is a Christian virtue and just as we are aware that there is a difference between hypothesis and assured result in science, just so there is often a difference between what some people say that the Bible teaches and what it actually teaches.

What shall we do when after study we are convinced that the Bible teaches a certain matter, and we also see no satisfactory answer to an hypothesis in science which conflicts with the interpretation of the Bible. *First*, we have good reasons to accept the Bible. *Second*, we know that science is characterized by change and tomorrow's investigations may bring the answer. *Third*, we may learn more about the Bible, and our previous explanation may be altered. *Fourth*, it is a sign of maturity in faith to be able to define the problem, and to carry it with one for years if necessary, without having the

answer, and yet in spite of this in no way be hindered in our life of faith and our labor of love. Our privileges should not be dulled nor our duty lessened by the difficulty.

Experiences throughout the years have encouraged me to believe that harmony does exist, even though I may never have sufficient information or insight to establish the harmony in a specific case.

The Biblical Miracles and Science

It seems to me that there is no relevancy between the Biblical miracles and scientific investigation, since we believe that in the miracles God worked in a way in which Nature, left to herself, would not work. Science in itself cannot affirm or deny the proposition that some cause worked in these specific cases which is not working in the laboratory.

The Christian Who Is a Scientist Should Not Expect To Be Successful Just Because He Believes the Bible

Christians must not conclude that because they are Christians science will not involve hard work for them—that the Bible and prayer will substitute for work. Though they should pray about all things, they should not substitute prayer for hard work and straight thinking. There is no "royal road to learning" for even the child of the heavenly King. This is true concerning God's revealed book, the Bible, and His unrevealed book, Nature.

It is true that through God's word one can learn things which the wise of the world do not know, but in the field of science Christians must study as surely as must the non-Christian scientist. Scripture is not a substitute for science, and science is not a substitute for Scripture.

Biology

Irving W. Knobloch, Ph.D.

Theories

These have been described by William H. George as the scientists most powerful pioneering tools. A good theory should not only correlate the known facts but should be fruitful in suggesting new experiments or approaches by means of which more facts can be established. J. H. Woodger might add to this that if the experiments suggested by the theory go contrary to expectation, then further data must be collected until the theory can be readjusted. It is important to understand here that a new theory does not displace an old theory but an old theory is toppled by contrary facts of large magnitude and a new theory is then established on the new facts. If theory and practice reach an equilibrium, then progress stops and a new breakthrough is to be hoped for. According to R. B. Braithwaite, a scientific system consists of a set of hypotheses which form a deductive system; that is, which is arranged in such a way that from some of the hypotheses as premises, all of the other hypotheses follow logically. The high level deductions are more general than the lower level ones. The empirical verification of one or more of all the lowest level hypotheses confirms the higher level hypotheses but nothing less than the verification of all the lowest level hypotheses would be sufficient to prove it; on the other hand, the empirical falsification of any one of the lowest level hypotheses, would be sufficient to refute it. To this may be added the thought of Sheldon J. Lackman that although theories are deductive in nature, they are either accepted or rejected to the extent that supportive data are acquired (or fail to be acquired) through the inductive method of science.

Little need be said about the usefulness of theories. It is generally conceded that, right or wrong, they stimulate a great deal of useful inquiry; Darwin's Theory

of Natural Selection is a case in point. The Ptolemaic Theory was very useful for over 1,000 years although it has now been succeeded by the Copernican Theory. Astrology is a fruitful source of income and Marxism is a source of power today. Other theories, largely abandoned are those on animal magnetism (Mesmer 1734-1815), acquired characteristics (Lamarck 1744-1829), abiogenesis (Aristotle 384-322 B.C.) phlogiston (Becher 1635-1682 and Stahl 1660-1734). It is interesting, in this connection, to note that an abandoned theory may be later revived (although this seems to be a rare occurrence). Prout believed in 1800 that all elements were made up of hydrogen but evidence collected on this point caused most scientists to reject his theory. Likewise Crookes' theory of isotopes was abandoned and in its later revival helped reinstate Prout's theory regarding the structure of the atoms of the various elements.

Since science is largely an interplay between fact and theory, there is certainly a lesson in this for Christians. Theories, we know, are usually tentative unless the data for their establishment is reproducible day by day (Gas Theory). No Christian need be dismayed because someone quotes a theory to him or her. Even facts are "slippery" things, ranging all the way from unanimous assent, to majority assent to scattered assent. Witness, for example, the facts of the miracles of Christ. They were certainly facts to many thousands but the ruling class was evidently not impressed. Even today there exists uncertainty about the factual nature of miracles in some minds. What hope then do we poor mortals have of convincing anyone with our theories and our facts?

Chemistry

Walter R. Hearn, Ph.D.

The subject under discussion in this column is the question posed in the March issue: "How does my being a Christian affect my scientific work?" The discussion will continue in subsequent issues, and the column is open to your comments and particularly to the sharing of your own experiences as an investigator whose over-all world view is that of an evangelical Christian. Do you do a different kind of research because you are a Christian, do you do the same kind of research in a different way, or do you experience little or no interaction between your Christianity and your research?

In a talk I gave recently I was trying to emphasize how restrictive are "the rules of the game" in research, and said that I thought the research papers I publish should bear no mark that the work was done by a Christian, because my philosophical presuppositions should be immaterial to the research. In the question period following the talk someone said, "Then being a Christian doesn't make any difference to you in the lab, does it?"

"I didn't say that at all," I replied. "A lot of things go on in my lab besides research—probably too many! My lab is also my office, where I prepare lectures, counsel students, talk to colleagues, worry over budgets, answer the telephone and the mail; think about research (if there's any time left), etc.—and I try to do all these things prayerfully." The questioner objected that I was defining research too narrowly. I think he wanted to define research as "what scientists do in their laboratories," and I was defining it as "what scientists do that can be published in research journals."

It seems to me that much of the power of the scientific method lies in its self-imposed restrictions, and that it is desirable for scientific literature to reflect the barrenness of science. Journals vary widely in many respects, some being more restrictive than others, but there is general agreement among scientists about what is appropriate in a research paper and what is not. The restrictions are set usually by editorial boards of scientific societies and enforced by editors and scientific referees. Few people who have not submitted manuscripts for journal publication realize that each manuscript is usually sent to at least two other scientists for criticism. These referees may recommend acceptance of the manuscript as it stands, acceptance with specified changes (sometimes total revision), or outright rejection; they are generally chosen because they have already published work of their own in the same field, often from among those who disagree with the author on critical issues. A referee may object that experiments

were not well designed or executed, that controls were not adequate or were not described in sufficient detail, that conclusions drawn from the results of an experiment were not justified, that attention was not given to the previous work of others in the same field, that essentially the same work has already been reported by others, etc. He tries to be sure that the work is reported in such a way that he or any other investigator skilled in that field could repeat the experiments and get the same results. He is *not* interested in the motives of the author or his philosophical outlook. In fact, even the scientific training, location, reputation, and record of previous publication of the author are essentially insignificant details; each manuscript must stand on its own merits, according to the rules of the game.

It is easy to criticize this system (especially when one of your own papers is severely criticized or rejected!) but most of us recognize it as the source of our confidence in the scientific literature. Occasionally an inaccurate or even downright fraudulent paper slips by, and occasionally a good paper is turned down by prejudiced referees; however, usually errors or frauds are quickly exposed by those who try to repeat the work, and it is possible to challenge a referee's opinion, to request another referee, or as a last resort to submit the paper to another journal for a fresh appraisal.

With this background, I wish to make the point again that if the research I *publish* is my real contribution as a scientist (and this is undoubtedly the basis on which I am judged by the scientific community), I do *not* want the fact that I am a Christian to show in it. In other words, I approve of the system of safeguarding scientific publication against inroads which might weaken it. When a theologian says that a Christian's theology should be revealed in his scientific papers, as in "the good old days" of 18th and 19th century science, he is essentially disapproving of the modern system of research publication. The theological barrenness of scientific literature should make one uneasy only if one fears the degeneration of science into a philosophical "scientism." It seems to me that the theologian who wants A.S.A. members to dedicate our papers "to the Glory of God as a Testimony of our Faith in His Son" as formerly done, is himself trying to convert science into a scientism. A better approach, it seems to me, is to insist that scientific publication remain devoid of theological and philosophical trappings, Christian as well as non-Christian; the philosophical barrenness of science should make the richness of the Christian Gospel stand out in contrast. We may then preach with conviction in a scientific age that science at its best cannot be ultimately satisfying, no matter how powerful and penetrating its method may be.

However, as an evangelical Christian, I am concerned about living a life which is not torn by spiritual schizophrenia, and I want to be able to pray about every aspect of my life, including my research work. How might God influence my scientific work in answer to prayer? How can I worship Him in the lab, and how can my life best serve as a witness to Jesus Christ, if we are to keep our research devoid of theology? Well, such questions have made me think about the factors which seem to control the kinds of research I do and the ways in which I go about doing it, and I have come to a few tentative conclusions.

The first conclusion is a general one, that our research is greatly influenced by the same kind of personal choices and circumstances that influence the course of everyone else's life. What are the major factors influencing the kind of problems we tackle? The nature of the position we hold, the equipment, personnel, and financial support available, the extent of our training, our ability and personality come to mind first of all. Even in a university environment where we are theoretically free to work on anything, our choices are limited by previous choices we have made, and by circumstances that are beyond our control. I realize the danger of over-generalizing from my own experience, but let me explain what I mean. In tracing back through my own life, it is easy to find first of all certain key decisions which seem to have had the most profound directional influence: the decision to go to college, the choice of a curriculum, application for graduate school, choice of a major professor, acceptance of certain positions, etc. These are decisions about which any Christian would pray for guidance. Beyond this lie aspects of our character and personality about which we also pray, and which ultimately affect all of our choices. Often these psychological factors are more difficult to pray about specifically because they are too much a part of us to be seen clearly, but they undoubtedly have a bearing on the way we do research. We may tend to do things which are hard (or easy) for us, we may prefer to do research which must be done neatly (or rapidly), we may gravitate toward exciting, risky projects (or toward "safe," sure-fire ones), we may like solitary work (or "team" work), etc. Finally, there are those circumstances which are most difficult to pray about intelligently because we never have facts at hand to get anything like God's perspective: a position opens up (or a grant isn't renewed), a top-notch graduate student happens to apply to our department (or our technician quits), a completely unexpected result turns up which puts us on the right (or the wrong) track, etc.

As I thought of these factors which shape the course of our lives and determine the kind of research we do, I realized that my being a Christian *does* affect my research if it makes any difference in my life at all: The

miracle we may expect to praise God for is not to be seen in the experiments we do, but rather in the fact that *we* are doing the experiment at this time and in this place to which God has brought us. The rules of the game in science specify that we must *not* see the Hand of God moving in the experiment; the "rules of the game" in my Christian life *require* that I see the Hand of God moving in me as I do the experiment and in all that brought me to the opportunity of doing it. Is there a "carry-over" between the two games? That is, does learning to live as a Christian necessarily make me a better scientist? I think not. It might, or it might even make me a worse scientist. I might be less inclined to enjoy participation in the scientific game if the joy of watching the Hand of God move became an overwhelming experience for me. I might therefore do less scientific work than a non-Christian with the same opportunities, or I might do it with less intensity and therefore perhaps not as well as a non-Christian might do it. On the other hand, if I have been conscious of God's guidance and realize that the opportunities I have are really unique, the feeling that God has prepared me for a specific piece of scientific work (perhaps partly by keeping me from becoming involved in some other investigation) may motivate me to throw myself into the task more wholeheartedly than anyone else could. What is your experience along these lines?

My second conclusion is a highly personal one, that God has led *me* in a most remarkable fashion in my scientific career. As I began to look back over the events that led me to my present situation I found so many hints of a "direct" influence of God that it seems perfectly obvious that my being a Christian has affected my research work. At what seem to have been turning points there was no vagueness about God's guidance, so it is reasonable to postulate His involvement in the events of my career. Let me give a few examples of "turning points" in connection with a specific research problem on which I have worked for the past five or six years, a study of hormone release by the anterior pituitary gland:

The difficulty in trying to tell such a tale is that there is really no starting place; I believe God has been active on my behalf since "before the foundation of the world"! But let us start with graduate school: The chain of events which led me to the University of Illinois and to my major professor were so remarkable that even at the time I had an intense feeling of God's direction. In my last year of graduate work I applied for a Fulbright to do post-doctoral work in England. At that time the period between application and notification was inordinately long, and I accepted a post-doctoral position in the U.S. before hearing that I had been awarded a Fulbright. Having already committed myself at Yale, I reluctantly declined the overseas Fellowship, wondering at the time whether I had

jumped the gun instead of waiting for a surer sign from the Lord about which way to go. As it turned out, my father became seriously ill during the summer I left for Yale, a circumstance which would undoubtedly have kept us from sailing to England had I accepted the Fulbright; at New Haven we could keep in touch with my family by phone and knew that I could fly home in a few hours if needed. After a year I felt I should return to Houston to be nearer my father, who was still in a relatively serious condition, so I wrote to Baylor University College of Medicine to see if a position in biochemistry might be open. It was (remarkably), and it was offered to me. The situation there at the time was not particularly favorable for the kind of research I had been trained to do, and I spent several "lean years" working on small problems I thought I could handle. Dr. John Brobeck, Head of the Physiology Department at the University of Pennsylvania, came down to Baylor Med as the main speaker for a Religious Emphasis Week, of all things. Now, Dr. Brobeck had been at Yale when I had arrived there and we had gotten acquainted through IVCF before he left for Pennsylvania, so we were already Christian friends when he came to Houston for a few days. One day he introduced me to Dr. Roger Guillemin of Baylor's Department of Physiology, whom I had not met previously.

Out of this meeting with Roger Guillemin came the chance to work on the hormone problem—he was looking for a biochemist to collaborate with him on isolation of ACTH-releasing factors from the hypothalamus. We began working together and had some results to publish in 1955. That year, however, again through a most remarkable series of circumstances, a position at Iowa State opened up and I was "propelled" toward it by the Hand of God, almost unwillingly. For quite a while it seemed that I had abandoned any chance of contributing further to the hormone project, which seemed to go very well in Houston but couldn't get off the ground in Ames. Then several excellent graduate students became interested in the problem, now supported by a grant to Iowa State from the National Institutes of Health, and we began to work hard on it. Nothing much came of our efforts, however, and it looked like "lean years" again. We got discouraged and almost gave up.

A new assay was developed by Guillemin which seemed to offer a ray of hope for us, so I sent one of my grad students to Baylor to learn the technique. We decided to try again, using the new assay, but didn't have the trained manpower to run enough samples to follow our isolation work. Morale sank to an all-time low as we faced the hard fact that no matter how much time we put in we couldn't get the job done. Just in the nick of time and by a truly fantastic series of circumstances, I discovered on our campus a girl trained in

perhaps the best hormone laboratory in the world, who had come to Ames with her graduate student husband hoping but hardly expecting to find a job where she could use her training! I hired her immediately, almost unable to believe my good fortune because expert technicians are exceedingly difficult to find in a small town, let alone someone with special training of such great value to us. Imagine my surprise when I discovered that she was also an evangelical Christian with whom I might pray! The Lord seemed to be letting me know that He wanted us to keep going when things looked black. With Peggy to help us we were in business, but the results we began getting were all negative. By now we had worked hard for several years with no publishable results, and it began to look as though we just weren't good enough to crack the problem. Meanwhile, the group I had left were publishing steadily on the problem.

I was very conscious of my responsibility toward the graduate students working with me, and was praying for some way to salvage a couple of Ph. D. theses out of what seemed to be a fiasco. Finally, in a desperation attempt to see what was wrong, we did a series of assays to check our technique and discovered that our values, although statistically valid, were quite different from those in the literature which we had accepted as standards. Our values gave us definite evidence that the substance we had been trying to isolate did not exist—or rather, that its biological activity could be accounted for by another known hormone. I sent our results to the investigator who had published the other values for criticism; he could find no flaw in our experiments, so we gained confidence enough to publish our own results. Suddenly our whole outlook had changed, just in time for my students to complete their dissertations, and our work became a real contribution to the field. Of course, we may yet be wrong in our new conclusions (the other investigator thinks so), but the point is that we were able to obtain good data to support them because we were forced to do certain experiments in our desperation. Had I *not* left Baylor and not been led through the additional lean years and discouragement, I would undoubtedly not have had the chance to make this particular contribution.

This has all happened quite recently, and in fact one of our papers is now in press and the other still an incompleting manuscript to which I shall return as soon as I finish writing this column. I am still emotionally moved by the dramatic way God rescued me, after opening up the opportunity in the first place and sustaining me even in the leanest years. My prayer is that I shall always remember seeing His Hand at work in this particular piece of research and continue to praise Him for it and to trust Him in the future. No, there was nothing miraculous in our experiments, nor did God provide any insights inaccessible to a non-Christian

—and our papers in the scientific journals will bear no indication that the work was done in an atmosphere of prayer. But there was a miracle—that God let *me* accomplish it—and it was a concentrated series of events

that brought it about. How could I say that being a Christian made no difference to me in research? It does, of course; the question is, what is the best way to say so?

Sociology

R. Heddendorf, M.A.

Problem Areas of Sociology: Medical Sociology and The Sociology of Mental Health

Part II

Medical Sociology

It would not be inaccurate to state that the sociology of medicine is about 10 years old. The field did not develop in a unilateral fashion, but rather, as is the case with many areas of sociological research, there was convergence from a number of conceptualistic viewpoints.

Perhaps the most advanced researches performed by sociologists have to do with social and cultural variations and their associations with illness. Some of the social variables studied here are social mobility, residential segregation, and socio-economic status. From such studies has come a clear understanding that there is a high correlation between some diseases and certain social variables.¹

Other medical sociologists have centered their interest on social relations in medicine. There seems to be much theoretical basis for such studies. Sociologists with little interest in the sociology of medicine have conceptualized medical relationships in terms of a social system. As such, they offer a unique opportunity to study relationships which are not well understood in our society.

Among the most significant of these is an article by Parsons in which he conceptualizes the patient as a deviant.² The suggestion here is that illness provides the individual with an opportunity to be relieved of his everyday responsibilities. Such non-performance of role requirements is a potentially threatening situation for such institutions as industry. In addition, illness is an unstabilizing factor for the patient and the medically non-professional person with whom he interacts. For these reasons, it is suggested that a prime function of the doctor and the hospital is to provide socially acceptable mechanisms for the personality adjustment of the patients and his family. Such a thesis would seem to

indicate that professional medical personnel have a responsibility beyond the limitations imposed by their medical skill.

A third major area of interest is concerned with viewing the medical profession as an institution. In this case also, sociologists particularly interested in formal organization, small groups, and bureaucracy have found the medical field to offer a rich source of problem areas.

Particularly significant studies have been made of the training of students in medical fields.³ Others have concentrated on medical associations such as the hospital and have found that the organization and structure of hospitals are factors in the efficiency which they achieve. Perhaps that area which has received the least attention is the relationship of medicine to such institutions as industry and the family.

Though the initial growth of medical sociology has been somewhat remarkable, there are several factors which would seem to indicate that further development will depend on evaluation of what has been accomplished. It will then be possible to direct studies toward those questions which are most pressing. At the present time, too much work is proceeding without adequate theoretical orientation. Such work results in little more than the development of isolated statistical studies. In addition, greater cooperation is needed from the medical profession before studies into such problems as doctor-patient relationship in the office environment can be made. Although more sociologists are serving on the faculties of medical schools and similar institutions, there are signs that such cooperation between the two fields is not being developed to the fullest.⁴

The Sociology of Mental Illness

Though mental illness has been understood in terms of underlying psychological and physiological processes

for some time, it seems to have been rather recently that social factors have been isolated as contributing factors. As such, mental illness has been conceptualized as a maladjustment to society. Reciprocally, sociological studies in this area would also be concerned with the attitudes of society toward the mentally ill person as a deviant.

As in medical sociology, the most rewarding work has been in the isolation of social and cultural factors which are related to mental illness. The original and widely held thesis that people living in an urban area of an associational society are more prone to mental illness has been brought into question. Nor does it seem to be true that the complexity and stress of modern life are causal factor of mental illness⁵. Both of these developments would seem to indicate that any relationship which might exist between social factors and mental illness is of a much more complex nature than was first believed.

Additional studies of a similar nature would seem to indicate that there is a strong inverse relationship between social status and rates of schizophrenia. Also, it has been shown, in a number of cases, that there tends to be a relationship between geographical mobility and mental illness, though it has not been established that such mobility is a causal factor. A number of studies have dealt with the possible relationship of social mobility and schizophrenia. The results, however,

tend to be inconclusive, for some studies would indicate that the downward mobile person is more susceptible to schizophrenia while others suggest that upward mobility seems to be the causal factor.

There have been several studies which have been concerned with the mental hospital.⁶ This emphasis has resulted, as in the case of medical sociology, from an interest in the functioning of diverse social institutions. Nevertheless, they have made a contribution in showing how therapeutic ends may best be achieved by improved organization. The historical change in the nature of such organizations would seem to indicate that such studies are long overdue.

¹For a fine bibliography of studies in this area, see Freeman and Reader, "Medical Sociology: A Review of the Literature," *American Sociological Review*, Vol. 22, (1957).

²Parsons and Fox, "Illness, Therapy, and the Modern Urban American Family," *Journal of Social Issues*, XIII, 4, (1952).

³See, for example, Merton, Reader, and Kendall (eds.), *The Student Physician*, Harvard University Press, (1957).

⁴See Straus, "The Nature and Status of Medical Sociology," *American Sociological Review*, Vol. 22, (1957).

⁵See Goldhamer and Marshall, *Psychosis and Civilization*, Free Press, 1953 and Eaton and Weil, *Culture and Mental Disorders*, Free Press, 1955.

⁶See Stanton and Schwartz, *The Mental Hospital*, Basic Books, 1954.

Philosophy

Robert D. Knudsen, Ph.D.

Before the last joint meeting of the A.S.A.-E.T.S., I had requested Dr. Gordon H. Clark of Butler University to prepare another column for the *Journal*. His observation of the proceedings at Goshen College stimulated the following comments on "Observation."

Observation

Gordon H. Clark

English speaking people, even those who use correct grammar and an attractive style, often do not know the rules of grammar as well as a foreigner who has deliberately studied them. An accomplished musician also and a skillful painter may not know very much about art. Similarly a practicing and brilliant scientist may be relatively hazy on the grammar of science.

At the last joint meeting of the ASA-ETS one of the scientists asserted that observation was *the* authority in science. Two or three other speakers confirmed the idea that science depends on observation, and in a context that suggested that observation is the only basis and authority in science. Since such an idea carries with it important conclusions for the philosophy of science and strongly colors one's views as to the relation of science to theology, this paper will advance certain negative considerations.

To avoid misunderstanding at the outset, it must be said that this argument does not deny that observation is an authority in science. The thesis is that observation is not the sole authority. There are other factors, other grammatical rules, other bones and sinews that determine the form of scientific law.

The simplest example is no doubt the use of the arithmetic mean. After the experimenter collects a list of readings, he adds them and divides by the number of readings. No observational necessity dictates this step. So far as experimentation is concerned, he could have used the mode or the median, instead of the mean. Similarly, to take a slightly more complex example, when a scientist uses the standard deviation, he squares the x 's; but there is no observational necessity that prevents him from cubing them. If the scientist should reply that the standard deviation ties in with the principle of least squares, one need only ask him why he does not choose to use the principle of least cubes. Many other examples could be mentioned. Now, since the laws of science depend on the mathematical forms chosen, and since different mathematical forms could be chosen, it follows that scientific law does not depend wholly on observation.

Ordinarily one might say that observation places certain limits upon the range of choice. The arithmetic

mean leads to the use of a plus or minus variable error. Such values, transferred to graphs, become areas and not points. Through a series of areas any one of an infinite number of curves can be passed. Therefore there is no observational necessity for choosing one scientific law rather than any other that passes through these areas. Although this permits an infinite range of choice, it also excludes an infinite range. Observation prohibits the choice of a curve that falls outside the limits of the variable error. Hence observation is *an* authority, even though it is not *the* authority.

But while this is the ordinary situation, it is not always true that the scientist chooses within the range of observation. Perhaps the most famous example is that of the Copernican astronomy. When Copernicus resurrected the heliocentric theory of Plato and Aristarchus, the Ptolemaic mathematics could more accurately predict the positions of the planets than the heliocentric theory could. Moreover, the heliocentric theory implied a stellar parallax, and there was none observable. To be sure, a stellar parallax was observed three hundred years later. But for these three centuries the heliocentric theory made its way in spite of observation. The charm of the mathematics overbalanced the force of the visible data.

At the last joint meeting of the ASA-ETS not only were there speakers from the physical sciences, there were also representatives of the social sciences, and these too stressed observation. Whether or not these speakers actually asserted that observation is the only authority in science is beside the present point; the present point is that social science can even less proceed on blind trust of observation.

One difficulty in sociology is that so few fundamental measurements can be made. The units are so often very poorly defined, or not defined at all. Therefore numerical laws and derivative measurements are impossible.

But the factor which removes sociology from sole dependence on observation, and which does so more obviously than in the case of physics, is the prominent part played by ethical norms. No one is satisfied to

count the number of divorces or the number of burglaries. Everyone, and sociologists above all, rush to explain the cause and the cure. But these proposals are essentially ethical and political principles. They are assertions of what ought to be; they are not descriptions of what is. For this reason ethics is not an observational science. Norms cannot be obtained by descriptive methods. Yet so often a sociologist refuses to justify the norms of which he makes use.

There are some philosophers who do indeed claim to raise norms on a descriptive basis. The argument against them cannot be detailed here. My ideas on this point can be found in the items mentioned in the footnote.¹ But enough has been said, I hope, to establish the need for a philosophy of science that will define the role of observation and indicate what other factors must be brought in play.

¹*A Christian View of Men and Things* (Grand Rapids: Eerdmans, 1952), chapters III and IV; and, *Dewey* (Philadelphia: Presbyterian and Reformed Publishing Co., 1960), pp. 13-41.

BOOK REVIEWS

Hooykaas, R. *Philosophia Liberia, Christian Faith and the Freedom of Science*. London, Tyndale, 1957. 24 p.

Reviewed by James E. Berney, Research Assistant, Agricultural Engineering Department, Oregon State University, Corvallis.

Hooykaas states the threat to the freedom of science. He shows how men in authority in the past have suppressed freedom of science by their intolerant views. He elaborates on how John Calvin was one of the first to put forth the idea that science cannot be built upon special texts from the Bible. His thesis in the paper is, that the inner freedom necessary to scientific work is fully guaranteed by a Biblical religion. He backs his thesis with a fair amount of evidence.

I would recommend this paper to anyone. I personally feel that we need to know the concepts set forth in this paper.

Hooykaas, R. *The Christian Approach in Teaching Science*, London, Tyndale, 1960. 20 p.

Reviewed by James E. Berney, Research Assistant, Agricultural Engineering Department, Oregon State University, Corvallis.

This paper elaborates how science has become very objective; not allowing theology or even philosophy to be admitted in any textbook of science and technology. He then goes on to show how complete objectivity in this realm is impossible. He reviews the Greek concept of man and explains how this view limited their investigation of science. He shows how the Biblical view of man led to widening of scientific investigation. The three points that he brings out for Christian science teachers are:

1. The teacher must be of the highest technical level.
2. The teacher must strive to develop the critical sense in pupils.
3. The teacher must point out where philosophical and theological views have influenced science.

I recommend this paper to anyone interested in the teaching of science.

SEPTEMBER, 1961

Science, Technology, and the Christian, by C. B. Coulson: Abingdon Press, New York, 1960; 111 pp., \$2.50.

Reviewed by Walter R. Hearn, Associate Professor of Biochemistry, Iowa State University, Ames.

I was prepared to like this book in advance by my admiration (from afar) of Coulson's work in theoretical chemistry and by my appreciation for his Christian viewpoint expressed in his *Science and Christian Belief* (Fontana Books, Collins, 1959). Dr. Coulson was formerly professor of physics at King's College, London, and is now Rouse Ball Professor of Mathematics at Oxford University; he is also a lay preacher in the Methodist church. He has written this little book in a popular but dignified style to challenge his fellow Christians to wake up to their responsibilities in the modern world, a world dominated by emphasis on a technology based upon science. His purpose is to provide a broad picture of the influence of technology in human life, illustrated by some specific problems, as a background for understanding and action by Christians.

A statement from the introduction summarizes his viewpoint: "Someone must claim that the Christian, just because he believes that this is God's world, must state his case, and show how the interpretation of some of the great Christian principles of conduct bears on such matters as the control of nuclear power, the implications of automation or the feeding of a huge and hungry world. If it be asserted that the Christian, as such, has no special knowledge of science, or technology, or of the politics which will be necessary in order to translate them into action, I shall reply that the politician can do nothing until he is supported—and often gingered—by a lively and informed public opinion. Every Christian should have his part to play in forming this opinion. Do we not claim that God's revelation in Jesus Christ gives us the clue whereby we understand God's will for the world? How then do we dare to keep silence when the scientists and technologists are fashioning the tools for a new earth?"

In Chapter One, the first and second industrial revolutions are contrasted, the principal difference being that the technology of the pre-1900 revolution was derived largely from traditional practice, while today's technology (and especially tomorrow's) springs from a rapidly expanding body of scientific knowledge. The author shows that much of the modern world's feeling of "lostness" comes from this unprecedented loss of tradition. The Christian is in a better position to minister to his contemporaries if he understands this clearly. In Chapter Two, the moral responsibility of scientists is discussed, and the point is made that although the frightening results of technology based on science have driven scientists to agree on negative aspects of

their personal responsibility to a very great extent, "agreement on a positive programme is only possible among people who share the same inner convictions out of which action grows." Believing that the Christian faith provides this conviction, Coulson urges that we understand the scientist's dilemma and show him that we share in his responsibility, rather than merely blaming him for opening Pandora's box.

The next two chapters deal with the relation of technology to Christian faith, first in a general way and then with particular examples. Christians should be ashamed of fearing technology and the rapid changes it is causing in our world: "We do not need to be suspicious of it as it must inevitably wean us away from the faith; we do not need to imagine that it has now made God unnecessary, nor that it is without any excellence of its own; we do not need to think of the machine as our implacable enemy. For if we understand our Christian doctrine of creation, the material things of earth may become the vessels in which we handle the things of heaven: and the greater freedom we enjoy—freedom to choose, freedom from oppressive physical labor, freedom to accept or deny the responsibilities that arise in all industrial production—may become one of the ways by which we fulfill God's destiny for us, and glorify Him in our daily work. Of course there are risks. But if it were not so, there would be no reward for reaching out. Our God is a refining fire." The specific problems he calls to our attention are the unequal consumption of energy throughout the world, the problem of food production and the population explosion, the changes in family life brought about by industrialization, and finally the kind of education needed for an age of technology.

In the final chapter, the possibilities of either science or technology as a unifying principle in the world are discussed. Science alone cannot serve as the cohesive force in the modern world because it is too refined and esoteric, and because the kind of "scientific humanism" which springs from it can be weighed and shown to

be wanting. However, a better case can be made for a "technological humanism" as a cohesive force, even between the opposing cultures of East and West. "What is the Christian commentary on this claim for technological humanism? In a single sentence it is this, that technology does indeed provide some basis for joint action, but that because the diagnosis of our society which the humanists propose is not deep enough, technology alone is not sufficient." A special plea is made for young people to consider technological work in underdeveloped countries as a Christian vocation: "There could scarcely be a finer vocation than to see that when it (technology) comes, it comes supported and interpreted by the best spiritual insights that we have."

In an epilogue, Dr. Coulson suggests three ways in which a Christian can help to fulfill his responsibility: First, we must see and understand what is happening. Secondly, we must see our current industrial revolution as a spiritual one as well as a material one. Finally, we must set the pattern of thought against which decisions and action may be judged. The emphasis throughout the book is on the need for *creative imagination* in blending our spiritual insights and Divine motivation with intelligent and courageous action, expressing the love of God to man *through* our science and technology rather than standing in reactionary opposition to them.

I was stimulated by this book because I found many things I have long thought about expressed with clarity and conviction. I feel that this is the kind of positive approach toward "reconciliation" of science and Christian faith in which the A.S.A. can take a leading part; the program of our 1961 Annual Convention encourages me that we are already moving in this direction. I find it as distressing to see the majority of Christians handicapped by misunderstanding and fear of science as it is to see my scientific colleagues living one-sided lives devoid of the joy of knowing God in Christ. Here is the real "gap" for us to bridge with all our hearts and souls and minds; and who can do it but we who are citizens of both communities?

NEW MEMBERS

The following have been elected members of the
Affiliation

Max Beard is a Supervisory Technician in the Chief Photographic Division of the Naval Ordnance Laboratory. He holds a B.S. in Chemistry from Washington State University. His address is 10703 E. Nolcrest Drive, Silver Spring, Maryland.

James E. Berney, Rte 1, Box 40, Troutdale, Oregon, is a Research Assistant at Oregon State University. He holds the B.S. and M.S. degrees from the same university with a major in Agricultural Engineering.

Joseph D. Brain is at the present time a student aide at Argonne National Laboratory. His future plans include graduate study under Atomic Energy Commission Special Fellowship in Health Physics at Harvard. He received the B.A. degree from Taylor University in the field of Physics in June 1961. His address is 9 Bertrano Drive, Wayne, New Jersey.

C. Maurice Burns received the A.B. degree from Marion College with a major in Zoology and the M.S. degree from the University of Alabama with a major in Biochemistry. He later received the Ph.D. degree from Kansas City University with a major in Bacteriology. At present he is Professor and Chairman of the Division of Natural Science at Central Wesleyan College, Central, South Carolina.

Louis L. Carter, Jr., 1293 Central Avenue, Memphis 4, Tennessee, received the B.S. degree from Wheaton College in June 1961. Beginning Sept. 1, 1961 he will be a student at the University of Tennessee College of Medicine.

James R. Crowder received his B.S. degree in Physics from Taylor University in 1961. He will presently be employed as Physics Research Assistant at the University of Illinois. His current address is 828 S. Armstrong, Kokomo, Indiana.

John A. Effenberger is an Associate Professor in the Department of Biochemistry and Biophysics at Iowa State University. He holds the B.S. degree in Chemistry from Fordham University and the Ph.D. degree in Physics and Chemistry from Iowa State University. His address is 953 Pammel Court, Ames, Iowa.

Guy F. Hershberger of 1306 S. 8th Street, Goshen, Indiana is a Professor of History and Sociology at Goshen College. He received the Ph.D. degree from the University of Iowa with a major in History in 1935.

John R. Hoelzel, Sr., 4100 Morehead, Apt. B., El Paso, Texas, received the B.S. and B.A. degrees from the University of Texas in 1958 and 1961 respectively. He is currently serving in the U. S. Army.

Rae R. Jacobs is a medical student at the University of Buffalo School of Medicine. He received the B.A. degree in the field of Zoology from Wheaton College in 1958. His home address is 253 Bryant Street, Buffalo 22, New York.

John Fulford Jarvis is a lecturer in Anatomy and is a part time consultant in otolaryngology at the University of Cape Town. He received degrees in his field at King's College and the University of London Hospital. His present address is 6 Cecil Road, Rosebank, Cape Province, South Africa.

Russell W. Johnson, 1018 Ruggles Street, St. Paul 13, Minnesota, is an Associate Professor of Biology at Bethel College. He received the B.S., M.F. and Ph.D. degrees in Forestry at the University of Minnesota.

Charles W. Jones is a Drafting Supervisor with the Vitro Corporation of America Silver Spring Laboratory. He holds the M.E. degree in Thermodynamics from Cornell University. His address is 4938 Hampden Lane, Washington 14, D. C.

Phillip W. Mange of 5204 Carriage Drive, Washington 22, D. C., is employed as a physicist by the U.S. Naval Research Laboratory, Washington 25, D.C. He received the A.B. degree in the field of Physics from Kalamazoo College and later received the M.S. and Ph.D. degrees in the field of Physics from Pennsylvania State University.

B. Howard Mudditt is employed by the Paternoster Press of London, England. He received the A.I.B. degree in 1921 from the University of London Kings College. His address is Hurdle End, Hatfield Heath, Bishops Stortford, Herts., England.

G. Lloyd Rediger, 1174 Payne Avenue, St. Paul 1, Minnesota, is employed by the Arlington Hills Presbyterian Church as Director of Christian Education. He received his B.S. degree from the University of Minnesota and is currently doing graduate work in Philosophy and Psychology.

Herschel C. Ries is a Technical Director for the Sudan Interior Mission. He received his B.A. degree in 1947 from Houghton College. His major field is in Physics. His address is Station ELWA, Box 192, Monrovia, Liberia.

James E. Rodgers, 1117G 9th Street, Albany 10, California, is employed as a research assistant at the University of California. He holds a B.A. degree from Westmont College in Chemistry.

Frederick D. Shannon is an Associate Professor of Chemistry at Houghton College, Houghton, New York. He received the B.S. degree in Chemistry and the M.S. degree in Organic Chemistry from the University of Akron.

Donald D. Starr of 515 - 23rd St., N.W., Canton, Ohio, is Dean of Malone College of the same city. He is also employed as Professor of Chemistry at the College. He received the A.B. degree in the field of Chemistry from Olivet Nazarene College in 1944 and the M.A. and Ph.D. degrees in the field of Inorganic Chemistry from the University of Illinois in 1946 and 1947 respectively.

Walter Lee Thomas is the Dean of Central Pilgrim College, Bartlesville, Oklahoma. He received his B.S. degree from Owosso College, M.A. from Michigan State University, D.Ed. from the University of Tulsa.

Walter R. Thorson, 164 Trapelo Road, Belmont 78, Massachusetts, is an Assistant Professor of Physical Chemistry at the Massachusetts Institute of Technology. He holds B.S. and Ph.D. degrees in Chemistry from the California Institute of Technology.

Robert J. Tonn is a Post Doctoral Trainee in Medical Zoology at the School of Tropical Medicine, San Juan, Puerto Rico. He received the B.S. degree from Colorado State University with a major in Zoology. A year later in August of 1950 he received the M.S. degree from the same institution. He later received the Ph.D. degree from Oklahoma State University. He also holds a M.P.M.P.H. degree from Oklahoma Medical School. His present address is Box 23, School of Tropical Medicine, San Juan 22, Puerto Rico.

David G. Tweedy teaches at School District No. 23, Kelowna, B.C., Canada. He holds a B.S.A. degree in Agronomy from the University of British Columbia. His address is Suite No. 1, 535 Rosemead, Kelowna, B.C., Canada.

Earl L. Van Den Berg, 25 Hutchinson Avenue, Hawthorne, New Jersey, is employed as a Biology Teacher at Glen Rock High School. He received the B.S. degree in the field of Biology from Rutgers University in June of 1961.

Gilmore L. Wagle is employed as a senior pharmacologist by Ciba Pharmaceutical Products, Inc. He holds the B.S. degree in the field of Biology from Wagner Lutheran College and the M.S. degree in the same field from Rutgers University. He also holds the M.A. and Ph.D. degrees in Biology from Princeton University. His home address is 26 Inwood Road, Chatham, N. J.

Jerome Waller, 19 Brookside Place, Northville, Michigan, is a student at the University of Michigan. He received the B.S. degree from Wheaton College in the field of General Science and the M.S. degree from the University of Michigan in the field of Zoology.

NEW ASSOCIATE MEMBERS

Donald G. Baker, 42 Wainfleet Road, Scarborough, Ontario, is an Assistant Professor at the University of Toronto. His major fields are in Biochemistry and Physiology. He received the B.A., and M.A., and the Ph.D. degree from the same institution in 1951, 1952, and 1955 respectively.

Carl P. Burman, 3630 Kingsley Street, San Diego 6, California, is a Senior Design Engineer with Fenske Fedrick & Miller of Los Angeles, California. He has attended the University of Illinois, the Illinois Institute of Technology and Washington University where his major fields were in Physics, Metallurgy, and Mathematics.

James E. Clendenin is a student at the University of Virginia. His major field is Electrical Engineering. His present address is 8804 Gramel Street, Norfolk, Virginia.

John Durkovic, 10316 Colesville Road, Silver Spring, Maryland, is a secretary with the Aeronautical Radio, Inc. & Arinc Research Corporation. He attended Crane Junior College, Illinois Institute of Technology, and the University of California where he majored in Electrical Engineering.

Harry C. Haakonsen is a student at Taylor University where he is currently majoring in Chemistry. His address is Taylor University, Upland, Indiana.

Wayne E. Hoover, is a student at Taylor University. His majors are in the fields of Physics and Mathematics. His address is RR 1, Wakarusa, Indiana.

Teddy Hong-Chong Marr is a student at Taylor University. His major fields are in Physics and Mathematics.

Glen W. Richardson, Box 231, Crossfield, Alberta, Canada, is Pastor at the Crossfield Baptist Church. He received the B.Th. degree from Central Baptist Seminary, Toronto, in May of 1950.

Robert H. Thompson, P.O. Box 5, Lake George, Minnesota, is an Instructor at Oak Hills Bible Institute, Bemidji, Minnesota. He received the B.A. degree in Philosophy from William Jewell College.