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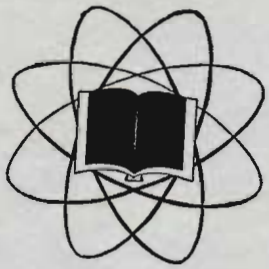

The fear of the Lord is the beginning of wisdom. Psalm 111:10

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The American Scientific Affiliation

(Incorporated)

The American Scientific Affiliation was organized in 1941 by a group of Christian men of science. The purpose of the organization is to study those topics germane to the conviction that the frameworks of scientific knowledge and a conservative Christian faith are compatible.

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The Journal Of The American Scientific Affiliation

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The Species As A Field For Gene Recombinations

DONALD S. ROBERTSON

The Bible tells us that Adam was the first systematist, for after the creation of living things, God gave him the job of naming them. Ever since then, man has been busily at this task, which is far from complete, as anyone who is familiar with the field of biological classification is well aware. If Adam was successful at all in naming living things, he must have used some system of classification to distinguish one kind from another. What system he used, we do not know, for there are many different criteria that can be used to distinguish between living organisms. For example, they can be classified as to color, habitat they occupy, size, mode of locomotion or structure, etc. What groups a classifier will recognize depends upon the system of classification being utilized. For example, if mode of locomotion is used, the bird and the bat may be included as a single kind, while they would be in separate groups if structure is the criterion chosen. This needs to be kept in mind in any discussion of the Bible kinds. It may be that the Bible does not use the same criterion for distinguishing kinds that modern science does.

Now when the scientist came along, he really took God's command to name living things seriously and set about establishing a system of classification that would adequately house all life. This system, depending primarily on basic structural differences, really got started with Linnaeus in the 18th century. Linnaeus used the species as the basic unit or kind of this system. Originally the species was defined in purely morphological terms, which is still the primary criterion used for recognizing species today, as anyone who has ever used a key to classify plants and animals knows. This system of classification, depending on form, was thoroughly worked out before the formulation of our modern ideas as to what is responsible for the form. Today it is recognized that what an organism looks like, its morphology, or to put it in genetic terms, its *phenotype,* depends to a great extent, on its *genotype* (another genetic term that stands for the genic make-up of the individual). In the light of modern genetics, the morphological similarity that distinguishes the members of a species results from similar (although not necessarily identical) genotypes.

Sexual reproduction provides an individual with its genotype from out of the pool of genes that the member of a species have in common. Since all members of a species are sharing the same genetic resources (*gene pool*), and since the genes determining morphology, there will result a certain fundamental similarity between members of a species[1]. This does not mean that each member of a species is identical to every other, for in the gene pool there will be many different forms of many genes (alleles), which can be combined in different ways to produce the individual variations found in any species. It follows then that different species are different because they have different pools of genes to choose from. These pools are separate and distinct, and will remain so as long as sexual reproduction does not take place between them. If it did to any great extent, a new and larger gene pool would result which would combine the characteristics of each of the original ones. Reproductive isolation then becomes an important criterion for distinguishing two species under the gene pool concept.

Thus a species is a group of organisms between which there is a more or less free exchange of genes and which is isolated from any similar group by a reproductive barrier.

Modern biologists do not view species as static things, but as Dobzhansky puts it, they are "...but a stage in the process of evolutionary divergence. Species are formed when a once actually or potentially interbreeding array of Mendelian populations becomes segregated in two or more reproductively isolated arrays. Species are accordingly, groups of populations, the gene exchange between which is limited or prevented in nature by one or by a combination of sexual reproductive isolating mechanisms"[2]. The fact that species are not static but are dynamic systems is the primary reason for the so called "species problem" that we are considering in this symposium.

The gene pool concept of a species may be theoretically correct, but in reality it has done very little to change the work of the systematist in classifying forms. He still depends primarily upon morphological characters without any, or very little knowledge of their genetic basis.

The chief practical contribution of the gene pool concept is the insistence upon reproductive barriers to delimit a species.

REFERENCES

1. In reality we have over simplified the role of the genotype in determining morphology. The ultimate phenotype of an organism depends upon an interaction of its genotype with the environment in which it finds itself. The same genotype might result in very different phenotypes if environmental conditions are diverse enough. However, basically it is still the genotype which determines how the expression of phenotype will be influenced by environment and to what extent.

2. Dobzhansky, Theodosius. *Genetics and The Origin of Species,* 3rd Edition, New York: Columbia University Press, 1951. p. 262.

Some Observations On Higher Education In The Netherlands

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The Dutch university is a paradise both for the students and the professors. Stressing the concept of freedom, the student body and faculty alike have many liberties that their American counterparts lack.

A Student's Paradise

The role of student (a term reserved for those attending a university) has almost the status of a profession. The student has very high social status, so some are tempted to choose that calling as a life-long vocation. One man in or near his forties had been attending for many years, going from one faculty and institute to another in order to keep covering relatively new subject fields. He was financed by a wealthy relative who provided that he would be given a liberal financial allowance as long as he remained a student!

Tuition costs are low, amounting only to 200 guilders (about $53.) for the entire academic year. Jobs are waiting for all who complete their studies to the candidate's or higher levels, for educational qualifications are established for many positions without regard for the competence of the individual.

The student writes few term papers. In the Sociological Institute at the University of Groningen, the student must complete one paper of 25 pages for his "candidate's'" and one of 60 pages for his "doctorial" examinations. In addition, the few persons who advance to the completion of work for a full doctor's degree must write and publish a dissertation. The costs of this publication are high, and the other costs associated with the examination ("promotion") and accompanying receptions bring expenses up to about 1,500 guilders or more. (Government loans are available to help pay these expenses.) No doctoral candidate is flunked at this formal, oral examination; to flunk a candidate would be practically the equivalent of firing his sponsoring professer.

Students are free to attend or not attend lectures as they wish. Although theoretically expected to attend from 3 to 15 hours of lectures and seminars a week, depending upon their level of advancement, they actually attend far fewer. Before their examinations, they discontinue all class attendance for three or four weeks.

There are few examinations, and these are scheduled individually with the professor whenever the student thinks he is ready for them. During his first year at the University of Groningen the sociology student takes a written examination in statistics and an oral one covering general sociology, sociological theory and methods, and social-economic history. He then is eligible to continue the additional two years required for the oral "candidate's-examination" which is given at the end of his third year. After two additional years of studies and at least three months of "experience" he may take the "doctoral-examination," which, if successfully completed, gives him the title of *doctorandus* (drs.). Only the dissertation and formal oral examination then stand betwen him and his doctorate. The foreign observer gets the impression that passing Dutch examinations depends primarily upon learning the viewpoint of *the* professor who dominates a faculty or institute and who gives or delegates authority for giving the oral examinations.

A Professor's Paradise

Professors also share in the benefits of freedom. They are very independent, once they become professors after passing through the lower ranks of subserviency as lectors, assistants, or persons in other occupations who wrote books significant enough to get them an academic appointment. (Few are appointed before the age of 35, and some not until late in life.) Professors choose or initiate their own courses (within broad limits), determine course content, set the standards demanded of students, and even do most of their own scheduling. Within the five to seven faculties which comprise the university, most have their own institutes and their own facilities. Each institute operates almost completely independently of all the others.

Teaching hours for the professor typically range from about three to five per week. Long vacations in summer (mid-May through mid-September or longer), at Christmas, and at Easter break the monotony of the year. Salaries are three to four times as high as those of skilled laborers. No occupational group has higher social status.

Of course, additional duties are expected of the professor. He must give—or, as the Dutch say, "take from the student"—examinations. He is expected to write his opinions in articles and books. (Careful empirical research is not needed where "insight" is the source of knowledge.) He serves (usually for a generous honorarium) as an expert on national and community problems. He may even engage in committee work for the university—if he volunteers for it!

Dutch committee work is different from that ot most American institutions of higher learning. One experi-

enced professor told me of his work as secretary of a major university committee. It met once or at most twice during the academic year. Whenever important matters of business came up, he and the chairman made a decision and then telephoned the other members to get their approval. Minor matters were handled exclusively by the two committee leaders.

The professor knows "everything." He must not be questioned critically, for he cannot make a mistake! Students do not embarrass professors with deep discussions in seminars and classes; they are there to learn what the fount of knowledge has for them. (Besides, they seldom have done enough reading and study to have a solid foundation for discussion.) The high prestige of the professor is interrelated with the authoritarian atmosphere that characterizes the typical lecture room.

Assignments can be given in several foreign languages. When students are confronted with difficulties in their reading or in the solution of statistical problems, they consult one another. Even if together they cannot solve mathematical or other problems, they seldom bring them to the professor. They must not let him know of their failure or cause him to be troubled with picayunish details.

Preparation for Paradise

To understand the Dutch system of higher education it is essential to know its historical and cultural background and especially to recognize the channels through which students have reached the university.

Compulsory education begins at the age of seven. The child first attends a publicly financed "lower school" which is either Catholic, "Christian," or public. At the end of grade 6 the parents decide whether he shall go on toward higher education, enter a technical high school, continue to eighth grade and then drop out of school, or enter an apprenticeship program that combines part-time work with vocational training. The age of 12 or 13 is hence a crucial one filled with anxieties for both children and parents.

If the child takes the first alternative, he will attend either a lyceum, gymnasium, or a higher citizen's school. If he successfully passes the terminal examinations (a large proportion fail), he is qualified automatically for admission to a university. (There are no liberal arts colleges.)

The five to six or more years of minimum schooling on the secondary level for persons entering the professions or other vocations which demand a university education are very strenuous. There are no extracurricular activities. Students study until at least 10:00 p.m. five or six evenings of the week. They must learn at least three foreign languages (English, French, and German), and in the classical schools (gymnasia) they must also study Latin and Greek. Other courses of study on the secondary level include history, mathematics, science, and a host of other subjects, partly dependent upon the type of school system. Much stress is placed upon rote memory and little or none upon cultivation of social graces and skills.

Student Life in Paradise

From this highly regimented, authoritarianly administered program the graduate of the secondary school comes to one of the six state universities (1 Catholic, 1 Protestant, and 4 general, and all with about ninety percent or more of their subsidized incomes from public funds). No longer is he obliged to meet assignments at specified dates, learn lessons daily, take frequent examinations, attend class faithfully, and study every night. His liberation is often devastating; the first year or two of university life are often almost completely wasted (academically speaking) in "riotous living."

To be sure, the university sponsors no extracurricular activities to distract students from their studies. But social expectations compel nearly every student to join an independent student organization. Which one he joins depends primarily upon his religious orientation, not his father's economic or social status, although that sometimes is also a criterion. In addition to the basic overarching student associations, often with elaborate recreational, eating, and social facilities, students join dramatic clubs, music clubs, art clubs, rowing clubs, football clubs, and other types of special purpose organizations.

Students do not live in dormitories; none are provided by the universities. They live individually in small rooms rented in various parts of the city. Having a roommate is considered entirely out of the question ("Isn't that immoral?"), but several students may rent rooms in the same private residence and thus share fun, fellowship, and even occasional intellectual discoveries with one another.

University libraries are usually highly decentralized, each faculty and institute having a fraction of the books and periodicals. Cataloging is cumbersome and poor according to American standards. A substantial proportion of the large collections (350,000 volumes in Groningen) consists of ancient tomes that are seldom if ever peered into in the twentieth century. Attendance in the main library reading rooms is remarkably high on cold winter days—student rooms are often poorly heated; the library provides a place to get warm. (But the stacks are bitterly cold!) Otherwise the facilities are used much less than those of American institutions.

Although American influence and an increasingly equalitarian atmosphere in Dutch society generally is producing gradual change, most students do not work while attending university except during summers. Work is frowned upon by the professors as an infringement upon intellectual endeavors.

Is Paradise a Paradise?

It is this very "paradise" of high status, voluntary class attendance, few examinations and assignments, low costs, and leisurely living for the students and high pay, high prestige, short working hours, much time for research and writing, few examinations, and almost no committee work for the professor that is described by Professor Perry Miller of Harvard University in *Atlantic Monthly* (March 1951) under the title, "What Drove Me Crazy in Europe"!

On the basis of his Fulbright lectureship in the Netherlands, Miller described the European system of higher education as fossilized, intellectually superficial, culturally shallow, highly compartmentalized, isolating the student from society around him, failing to encourage critical reading and thinking, failing to recognize and meet the crises of students, and misinterpreting America "where-all-the-people-are-so-superficial-and-materialistic." Other American participants in the Dutch educational system have come away with similar impressions, although most have not "gone crazy" because of the experience. In fact, many of them, seeing the advantages of the system without recognizing its disadvantages, have "gone crazy about" the system and wished that many of its admirable features could be incorporated into American higher education. Perhaps a golden mean between the Dutch and American systems of education would produce a nearly ideal program.

General education is not an objective of the Dutch university. That is (presumably) provided in the secondary schools, although their emphasis upon literary, philosophical, and language studies excludes other significant areas of human knowledge.

The European university is not a liberal arts college. Isolation of each faculty from the others and the relatively little over-lapping of various faculties by students makes for a compartmentalization that is not productive of critical thinking, broad educational knowledge, or recognition of the interrelationships between the various academic disciplines.

All the American graduate students and college professors with whom I "compared notes" believed the Dutch university education to be on a much lower intellectual level than that of the typical American institution of higher learning. Excessive freedom after extreme regimentation apparently is not conducive to higher intellectual achievement for most people.

While it provides a utopian paradisiacal environment for three or more years of a student's life and a secure ivory tower for the professor, the cultural survival of semi-medieval traits in the twentieth century makes Dutch higher education a prime illustration of cultural lag. Much "freedom" with little obligation becomes unprofitable both for the individual and society when democratic and humanitarian objectives are used to evaluate the ends and means that are involved.

REFERENCES

Conant, James B., "Education in the Western World," *The* Atlantic Monthly, vol. 200, no. 5, pp. 73-77 November 1957.

Daling, John T., "A Look at the Dutch," *The Reformed Journal*, Part I: vol. 7, no. 5, pp. 22-27 May 1957; Part II: vol. 7, no. 6, pp. 13-16, June 1957.

Kinne, Ernest W., "A Fulbrighter Views Dutch Education," *Journal of Higher Education*, 30:15-26, January 1959.

Miller, Perry, "What Drove Me Crazy in Europe," *The Atlantic Monthly*, vol. 187, no. 3 pp. 41-45, March 1951.

Sequence In The Days Of Genesis One

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The occasion of this article is a thesis concerning the days of Genesis 1 presented by Dr. Meredith Kline in the May, 1958 issue of the Westminster Journal. Negatively, this thesis is that Genesis 2:5 "constitutes a decisive word against the traditional interpretation", namely that the order of narration in Genesis 1 "coincides with the actual sequence of creation history". This thesis, therefore, involves a rejection of the chronological sequence of the days of creation as narrated in Genesis 1. Positively, the thesis may be regarded as "the not so traditional interpretation which regards the chronological framework of Genesis 1 as a figurative representation of the time span of creation and judges that within that figurative framework the data of creation history have been arranged according to other than strictly chronological considerations." Thus the days are merely a literary framework or device of no more importance than the figurative elements of a parable.

The thesis of this present article is that while the "literary framework" hypothesis is a coherent interpretation of Genesis 1 and 2, it is nonetheless only one alternative and is not, therefore, compellingly cogent. I shall attempt to present another alternative which is consistent with modern scientific theories while at the same time preserving the sequential significance of the days.

Dr. Kline comes to his interpretation of Genesis 1 *via* an illuminating exegesis of Genesis 2: 5-7. In this latter passage he discerns a cause-and-effect relationship: there was no vegetation yet in the earth "for Jehovah God had not caused it to rain upon the earth: and there was not a man to till the ground." This cause-and-effect relationship, he very appropriately observes, indicates that natural law as we know it today was operative during the days of creation. Thus, even between the various creative acts of God, natural law was operative. Dr. Kline refers to this as the natural providence of God, as contrasted with a supernatural providence which would set aside what we today know as natural law. Finding Genesis 2 to teach natural law and natural providence, Dr. Kline finds it impossible to accept any traditional view of Genesis 1, and asserts that any variation of the traditional view necessarily requires a supernaturalistic setting aside of natural law between the creative acts of God. Thus in order to harmonize Genesis 1 with the natural providence of Genesis 2 he cancels out the traditional interpretation of a chronological sequence of the creative days. In this manner he secures consistency betweeen the two accounts while preserving the idea of natural providence.

Without going further into the reasoning of Dr. Kline, I should like now to challenge the thesis that natural providence and chronological sequence cannot be harmonized reasonably in Genesis 1. The argument will proceed by means of correlating the Biblical data with certain scientfic theories.

A. Genesis 1:1-2. There are several possible interpretations of these verses, among which are the Restitution Theory and the Caption Theory. The traditional interpretation which regards verse one as stating the "ex nihilo" creation of the original materials of the universe, and verse two as describing the condition of those materials, appears to be a reasonable interpretation. Dr. E. J. Young writes that Genesis 1: 2 describes the condition which had existed "from the point of absolute creation until the first creative word was spoken" in verse 3. (1) These verses would then refer to the sum total of all matter in existence, so that none of God's creative acts during the subsequent Days involved the creation of new matter "ex nihilo", but rather that these creative acts modified and gave structure and system to the previously created "waste and void" materials. The successive creative acts introduced new relationships and new natural laws into the materials created "in the beginning."

The eminent scientist Dr. George Gamow once wrote, "the present chemical constitution of our universe was decided in half an hour five billion years ago". (2) This statement can be interpreted as indicating that the universe had a sudden origin. If so, then this scientific position clearly coincides with the creation "ex nihilo" of Genesis 1:1. The same scientist also wrote that "we assume that the universe started from a very dense state of matter". (3) The theory involved here is that of the expanding universe, in which this original dense body of matter gradually expanded according to regularly operative natural law, thus forming the cosmos of today. It would not take too great a stretch of the imagination to correlate this original dense state of matter with the situation described in Genesis 1:2, a state of unformed, unshaped, undeveloped, unexpanded matter.

B. The First Day of Creation. The Bible states that the first of the secondary type of creative acts of God was the creation of light. Dr. John DeVries writes, 'The Hebrew word for light includes the con-

cepts of . . . heat and electricity as well as light. . . . These are the forces which are the prime movers of the machinery of nature." (4) Thus the word "Light" can be interpreted to mean "energy in the form of light". We may, accordingly, visualize God creatively injecting energy into the previously inert and static materials described in Genesis 1: 1-2. Further, accepting the premise of natural providence operating from the very beginning of creation, we may visualize this energized matter beginning to operate according to natural law. And still further, if one wishes to accept the expansionist theory of the universe, the first day of creation may be viewed as the beginning of its expansion. Dr. Gramow writes, "In the early stages of its expansion, radiant energy was dominant over the mass of matter." (5) The parallel here between the scientific term "radiant energy" and the Biblical term "light" as explained by Dr. DeVries is striking.

C. The Second Day of Creation. "And God said, 'Let there be a firmament' . . . And God called the firmament Heaven". The firmament, being that which separates "the waters which were under the firmament from the waters which were above the firmament", is the air or atmosphere surrounding the planet earth. The Bible here for the first time directs our attention to that part of the universe which was to become the habitation of man; up to this point the attention has been directed to the universe as a whole, whereas from this point forwards the attention will be confined to the earth and its preparation for man. This observation indicates that in this day the planet earth had for the first time been differentiated from all the rest of the materials of the universe. It is reasonable to suppose that what the Bible is describing for the earth was also happening for the other planets and heavenly bodies, namely their respective separation from each other as individual entities. Dr. DeVries writes that on this day God made "the separation of our earth from the other stellar bodies". (6) Thus, implied in the creation of the firmament, or Heaven as God named it, is the separation of the earth and the other cosmical bodies from each other.

Once again the parallel accounts of science are noteworthy. Dr. Gamow theorizes that after 250 million years "the gas broke up into giant gas clouds, slowly drifting apart as the universe continued to expand . . . These primordial balls of gas would have had just about the mass that the galaxies of stars possess today." (7) This may be interpreted as corresponding to the work of the second day of creation as the second major step in the formation of the universe.

D. The Third Day of Creation. "And God said, 'Let the dry land appear . . . Let the earth put forth vegetation, plants yielding seed, and fruit trees bearing fruit' ". After God separated the earth as a distinct planet from the other heavenly bodies, he began to prepare the surface of it for the eventual habitation of man.

This verse provides the most obvious difficulty in maintaining the natural providence of the Days of creation. The difficulty arises from the natural law operative today that vegetation needs sunlight in order to flourish, and since the sun was not created until the fourth day — i.e., *after* the vegetation was created on the third day — it is apparent that natural law as we know it today could not have been operative if the third and fourth days are interpreted as sequential.

There is, nevertheless, a possible explanation of this difficulty which is neither artificial nor forced, and which retains both the concept of sequence and the concept of natural law. Natural law requires that vegetation be dependent upon light. But God had already created light on the first day. This energy in the form of light was apparently diffused throughout the universe without being concentrated in one source. This may perhaps mean that the earth at that time was continually surrounded by what we today would call twilight—a very dim light, but nonetheless light. Dr. John DeVries comments, "Where this light originated we are not told, but we do know that there are many possibilities for its origin in addition to the sun." (8) The vegetation which God created the third day could very well have existed in such light.

To this interpretation it may be objected that this vegetation produced "plants yielding seed, and fruit trees bearing fruit." How could this weak cosmic light produce full-grown trees bearing their fruit? In reply to this objection, however, there is no need to consider these trees to be full-growth by present standards. They may well have been fully mature, bearing fruit and producing seeds, but being dwarfed or stunted by comparison with the present.

This interpretation does not do violence to the requirement of natural law. On the contrary, it is precisely what one would expect, given the natural laws which had been brought into existence up to that point. Present natural law, in which vegetation depends directly upon the sun, simply had not yet been brought into operation by God. When, on the fourth day, the sun was created, the earth's vegetation became dependent upon its concentrated energy, and could develop into the large specimens current today. But before God created that natural force, the forces which had been operative previous to the fourth day could have sustained vegetation on a miniature scale.

E. The Fourth Day of Creation. "And God said, 'Let there be lights in the firmament of the heavens to separate the day from the night'."

If one accepts the expansionist theory of the universe, one must consider that the natural process of expansion had been continuing unabated through what Genesis refers to as the third day. When in God's

judgment the process of natural development had reached the proper point, he creatively injected a new force or law into the universe. This was the concentration of light in the body of matter we now call the sun. We would have to consider—in order to retain the idea of natural providence—that this body of matter was already in existence as a separate body, but without light. The original creation produced all existent matter, so that during the subsequent Days of creation no new matter was created. The creative acts of the Days were all supernatural modifications of or additions to the natural laws governing matter. Thus the creation of the sun was not the creation of new matter out of nothing, but the injection into it by the supernatural creative fiat of God of a new natural law. God said, "Let there be lights", not, "Let there be additional bodies of matter".

The emphasis in all the Days is the preparation of earth as man's habitation. The dry land provided a place to live; the vegetation provided food; sunlight provided such things as day and night, measurement of time, and regulation of seasons. Further, the more powerful light of the sun, by causing more rapid growth of vegetation, provided a more abundant source of food for a large population.

F. The Fifth Day of Creation. "And God said, 'Let the waters bring forth swarms of living creatures, and let birds fly above the earth across the firmament of the heavens'."

Birds and fish, besides providing additional sources of food supply for man, are cold-blooded and the biologically simpler forms of animal life. This is also in harmony with natural law, which affirms that the biologically simpler forms of life appeared before the biologically complex forms. Thus the sequence of Genesis 1 is in broad harmony with the sequence of science.

G. The Sixth Day of Creation.

Biological science places man at the end of the series of the appearances of new forms of life, after the more complex animals and mammals. This order is identical with that of Genesis 1, "And God said, 'Let the earth bring forth living creatures according to their kinds: cattle, and creeping things, and beasts of the earth . . . Then God said, Let us make man in our image'."

H. The Seventh Day of Creation. "And He rested on the seventh day from all his work which He had done."

After the creation of man, "the heavens and the earth were finished", and God rested from his creative labors. For natural science this would mean that since the appearance of man on the planet earth no essentially new forms of life, or new natural laws have appeared. I am not aware of any difficulties regarding this point.

There are two concluding observations. First, that this article has discussed the problem of *sequence* in Genesis 1, not the problem of duration, i.e., the length of the days. I have simply assumed that the days were of variable and indefinitely long duration. Second, there are probably a good many unresolved questions left by this article, both from the side of science and from the side of theology. My major thesis has been, however, that it does appear to be possible to satisfactorily correlate natural providence with chronological sequence in the Days of Genesis 1. Thus the conclusion: the so-called "framework hypothesis", while coherent, is not compelling.

REFERENCES

1. E. J. Young, *An Introduction to the Old Testament*, p. 53.
2. George Gamow, in *Scientific American*, Sept. 1956, p. 154.
3. *Ibid.* p. 150.
4. John DeVries, *Beyond the Atom*, p. 98.
5. George Gamow, *op. cit.*, p. 150.
6. John DeVries, *op. cit.*, p. 99.
7. George Gamow, *op. cit.*, p. 152.
8. John DeVries, *op. cit.*, p. 99.

The A.S.A. In Retrospect

William J. Tinkle

How thrilled was I to receive a letter in the latter part of 1941 reporting that a new organization had been formed and that I had been mentioned as one who might be interested in membership. Once before an invitation had come to join an organization dealing with science and the Scripture but I had declined.

Since the founders were cautious about the personnel of the new group, they invited a few of us to a little private meeting and then Peter Stoner recommended Jesse C. Brandt and me for membership. This was two or three months after the initial meeting in Chicago. A report of this meeting has been given to our readers several times and it always intrigues me.

How those memories come flooding back through these eighteen years! What a thrill to meet men who were trained in science as you were and who had also a belief in the Bible. You could say what you believed about spiritual realities without encountering a silent stare, more vocal than words. A genuine fellowship was realized, replacing the loneliness of disagreement, which is ten times worse than the desert.

Some of the benefits received have been over and above the original plan. I have been stimulated to learn science outside of my own field, which is biology. This discipline should be of value to any scientist in view of the great specialization which has taken place. I realize that my biological principles may be in error if I do not understand other sciences, physics for example. Does not ignorance of the ways of God also lead to error?

Interesting new research has been reported at our

meetings but if we did this alone we would become broad and thin and lose our unique purpose. At a convention a good research paper was given and our members appreciated it. But one of the more spiritual men said to me privately, "I should like to ask that author to what chapter and verse in the Bible his paper refers".

We do not have enough people writing for our literature, in view of the fact that our message must be given largely in this way to a scattered people. Correcting and criticising the writing of others is a necessary work, and there has been no lack of members willing to do so.

The A. S. A. has conducted a good open forum but such a method is limited in its scope of usefulness. We ought to settle some principles, then go out and make converts among other scientists. We have no united, forceful campaign to correct the mistakes of scientists which have lessened faith in the Bible. Some members even seem willing to admit that there may be mistakes.

Doubtless you are familiar with the legend of the ostrich, how it hides its head in the sand and, seeing no danger, thinks there is none. Actually, however, this bird does not do this, but I contend that naturalists should search for some creature that does so, because it is such a good illustration of what people do. Many church people say there is no conflict between the doctrines of scientists and the Bible, and to be sure we all wish there were none. But the discrepancy is too big to be solved by ignoring it and we of the Affiliation should strike at the ostrich attitude of the liberal Christians of our time.

Executive Council Meeting

Saturday, March 21, 1959

(The following is a summary of the Minutes as officially recorded by Secretary Hearn.—Editor)

Old Business—Journal: Considerable concern has been expressed as to the long time involved in getting the Journal printed and mailed. Several printing firms are being contacted in the plans for more regular appearance of the Journal.

Nominating Committee—A nominating committee was appointed consisting of Hendrik J. Oorthuys, chairman, F. Alton Everest, and Donald S. Robertson.

Directory—A new directory is to be published in 1959 as a supplement to the Journal.

1960 Convention—The 1960 Convention will be at Seattle Pacific College if arrangements can be made with the College. Robert P. Dilworth was appointed General Chairman, Harold T. Wiebe, the Local Arrangements Chairman, and Hendrik J. Oorthuys as Program Chairman. Brian P. Sutherland and Herbert L. Hergert are on the Program Committee.

Story of the A.S.A.—The Editor was requested to undertake the preparation of a new edition of the pamphlet "Story of the A.S.A."

Publicity Material—Discussion took place on two types of publicity material, one for recruiting new members, the other concerning the Journal and other A.S.A. publications. Action was deferred until after foundation support application took place.

Foundation Support—Dr. Hearn is looking into the possibility of obtaining foundation support for expanding A.S.A. activities, particularly for obtaining a permanent secretary and office.

A.S.A. Newsletter—Mr. Everest was commended on his work in preparing the Newsletter. It was agreed that it filled an important place in providing rapid "press coverage" of items in which Journal coverage came late.

Incorporation in Illinois—An A.S.A. lawyer is looking into the possible advantages of changing our incorporation to Illinois from California, where we are presently incorporated.

Darwin Symposium Volume—Dr. Russell Mixter, Editor of the Volume, reports that Eerdman's will publish the book during 1959. Questions of royalties going to the A.S.A. and what is to appear relative to the A.S.A. is to be cleared up with the printer.

A number of other minor items were discussed including encouragement to form local sections by explaining the steps necessary in the Newsletter, some previews of the Joint E.T.S.—A.S.A. Meeting and our status as an income tax deductible organization.

The Secretary was requested to send a letter of appreciation to Hendrik Oorthuys for his fine service on the Council and as Secretary-Treasurer.

The meeting was held at Moody Bible Institute with H. Harold Hartzler, Walter R. Hearn, John R. Howitt, Henry Weaver, Jr., and D. N. Eggenberger present.

BIOLOGY

Irving W. Knobloch, Ph.D.

Genetics In Russia

Trofim D. Lysenko is an agricultural scientist who is supposed to have helped save Russia from a famine during the last war by his work on millet. Although he has had little formal training in genetics, he successfully overthrew Mendelian genetics in his country and substituted his own system. This is based upon the theory that "changes in the conditions of life bring about changes in the type of development of vegetable organisms. A changed type of development is thus the primary cause of changes in heredity." Due

to his success with millet, Lysenko was able to have his ideas sanctioned by the Central Committee of the Communist Party. Science became a matter of politics therefore and thus a two-edged sword. Dissenters were silenced in an effort to ensure conformity and secondly it will become embarrassing to the political leaders if the weight of proof should go against the theory.

Some quotations from Lysenko are given here to show the level of his comprehension:

" - - in order to get a particular result, one must want to get exactly that result; if you want to get a particular result, you will get it . . . - and further, I want the sort of people who will get what I want (require)."

"When he grasps Bolshevism, the reader will not be able to give his sympathy to metaphysics, and Mendelianism (Mendelism) definitely is pure, undisguised metaphysics."

" - - the only thing left from the so-called Morgan chromosome theory of inheritance is the chromosomes, and the whole theory of Morganism collapses."

Some of the weightier reasons why western scientists do not accept Lysenkoism are as follows: controls were not used in the experiments, the strains of organisms were not homozygous for the traits being investigated, the use of statistics in evaluating the results was frowned upon and lastly, duplication of the alleged experiments has failed to reveal comparable results. Since these essential criteria of good experimentation were ignored, we have no other course before us but to challenge his theory.

A recent visitor to Russia informs me that Lysenko holds a very important position there and wields a great deal of influence. My own perusal of the Plant Breeders Abstracts leads me to the opinion that there is some active opposition to Lysenko in Russia. Several breeders report in the Russian literature that they have been unable to confirm Lysenko's experiments. Another hopeful sign is the fact that there is a small group near Moscow headed by Dubinin, who read western literature on Genetics and follow the work on Mendelian genetics as much as they dare.

The above is a rather sad story and it points up the desirability of free discussion and the complete divorcement of science from politics. We have no comparable situation here in this country except in the field of organic evolution where any reference to the possibility of any kind of divine creation is treated with disdain and vilification.

References

Winchester, A. M. 1951. *Genetics.* Boston, Houghton Mifflin Co.

Baker, John R. 1958. *Science and the Sputniks.*. Occ. Pamph. No. 18, Society for Freedom in Science.

Zirkle, Conway 1949. *Death of a Science in Russia.* Philadelphia, University of Pennsylvania Press.

Atomic Energy and Peace

This is the title of a small booklet written by Freda Wuesthoff and distributed by the Society for the Scientific Study of Peace, at Geneva, Switzerland. The address is La Fresnaie, Troinex, Geneva, Switzerland. It deals with atomic structure, radiation and both war and peace time uses of atomic energy. One of the conclusions reached is that war has defeated its own ends and any new war would be pointless because the destruction that would be brought even upon the victor would no longer bear any relationship to what could be won by the war itself.

I agree whole-heartedly with another of her statements which is— "There are also some people who refuse to embark on such contemplations (the investigation of atomic structure and power) as these for religious reasons which claim that it is not for man to know these things. I myself believe that if Understanding has been bestowed upon us (she means, the ability to think), then it cannot be sacrilege for us to make use of this gift."

CHEMISTRY

Walter R. Hearn, Ph.D.

Probably many A.S.A. members were attracted to George Wald's article in *Science, 128,* 1481 (12 December, 1958), "The Significance of Vertebrate Metamorphosis," by its unusual introduction—a quotation from the third chapter of the Gospel of John! The author used Nicodemus' question about the nature of a second birth to draw attention to the fact that all living things have a life *cycle,* beginning with birth and ending with preparation for a second *physical* birth, this time of their offspring. Wald makes a convincing case for "metamorphosis" as a phenomenon common to the whole vertebrate stock including man, a process by which the animal is prepared to leave its natal environment; in order to reproduce, the animal must eventually return, thus completing its life cycle. To return, a second metamorphosis may be necessary which may be almost a direct reversal of the first one. In his closing paragraph, Wald says:

"Our history as vertebrates is not dust to dust but water to water. From this point of view Nicodemus' great question can be given a broad and positive biological answer. Every animal can and must return to the 'womb'—not, indeed, to be born again; but to bear the next generation. For a catadromous fish, the 'womb' is the sea; for anadromous fishes and amphibia, a pond or stream; for land vertebrates, a uterus or egg."

Professor Wald, eminent biologist of Harvard and

Woods Hole, is best known for his work on the visual systems of vertebrates (which he says led him to this thesis), but he presents evidence for changes in many other biochemical systems during vertebrate metamorphosis. His paper amounts to a reaffirmation of the principle of "recapitulation"—but this time on a biochemical basis. For instance, he points out that the eye pigment of certain euryhaline fishes (those which can live in water of widely varying salt concentration) changes during their life cycle: If the fish lives in salt water but goes upstream to spawn, as in the case of salmon, the adult pigment will be the "salt-water type" based on retinene (from vitamin A_1), but before the adult returns to its natal environment the pigment changes to the "fresh-water type" based on dehydroretinene (from vitamin A_2). The reverse situation applies to certain fresh-water eels which spawn in salt water. In the familiar metamorphosis of tadpoles, the change from a fresh-water environment to a dry-land environment is accompanied by changes in the type of visual pigment, the type of hemoglobin in the erythrocytes, the nature of the plasma proteins, and the mechanism of excretion of nitrogenous compounds.

Of course, as in the case of anatomical "recapitulation" these observations in themselves do not necessarily strengthen the case for phylogenetic evolution, but Wald interprets them in this way, postulating that the ancestral vertebrates arose in fresh water and possessed visual systems based on vitamin A_2. The most speculative part of his thesis is probably the suggestion that puberty represents the vestigial remains of the second or reverse metamorphosis in the case of the land vertebrates. "To be sure, this does not prepare a land vertebrate to migrate, for the natal environment is now segregated, and puberty prepares the animal only to mate. Here only one representative cell—the spermatozoan—completes the return to the natal environment; and this, of course, undergoes a profound metamorphosis before being launched upon a migration as formidable, relative to its size, as that of any salmon." It is well established that the human fetus manufactures a different molecular species of hemoglobin from that of the adult and that the shift to the adult type comes after birth, so the term metamorphosis can legitimately be applied to the human species. Webster gives the zoological definition of metamorphosis as "a marked and more or less abrupt change in the form or structure of an animal during postembryonic development."

Here of course we are dealing with changes in structure at the molecular level, changes in metabolism rather than in gross morphology. As I have pointed out ("Biochemical Complexity and its Significance in Evolution," *JASA,* June, 1955), this will surely be the predominant theme in future considerations of the extent and precise mechanisms of evolution. The evidence from comparative biochemistry and chemical embryology presented in Wald's article certainly does not "prove" that biochemical evolution has occurred, any more than Darwin's assembled evidence "proved" that morphological evolution had occurred. However, in reading this paper I think I felt the kind of excitement that some of Darwin's contemporaries must have felt over his writings: here is a theory that suggests new things to look for and brings together many kinds of evidence into a unified concept! The theory may not be true, of course, but meanwhile it is useful because it is exciting and challenging. And some day, if biochemists are sufficiently clever and diligent, we may be able to find out if the theory is true.

In subsequent issues of *Science* a number of correspondents complained that Wald's poetic imagination had carried him too far, which may be true. There was also a letter complaining that "twisting" the passage from John to make it refer to physical rebirth was inexcusable, and suggesting that the editors consult theologians as referees to prevent such misuse of Biblical quotations. On thinking back over many sermons I have heard, I decided that Wald's use of this verse out of context was no more serious than much of the "poetic license" with Scripture so common in Christian preaching. And usually my objection to it there is not that it is done, but that it is disguised as logic and not honestly presented as poetic illustration. To go back to the ideas presented in this column last time, I think a Christian who does scientific work (or one who preaches!) should be able to look at what he is doing poetically as well as logically, if his life in Christ is to be really "abundant." Darwin, many of you will recall, complained eventually of losing his taste for beauty in literature, music, and art because of his engrossment in mechanistic thought. Should not those of us who *have* been born again spiritually have a richer life than that?

A third area of significance in evolutionary considerations to which I called attention in my 1955 paper (besides comparative biochemistry and biochemical embryology) is that of biochemical genetics. An excellent review of the status of human biochemical genetics is provided by Laurence H. Snyder in "Fifty Years of Medical Genetics," *Science, 129,* 7 (2 January, 1959). This paper, Dr. Snyder's 1958 AAAS Presidential Address, is as exciting and challenging as the one by Wald referred to above. There are now many well established cases in which inherited diseases, known to be controlled by a single gene, can be pinned down to a single abnormality in a specific metabolic pathway. For example, Vernon Ingram of Cambridge (*Nature, 180,* 326 (1957).) showed that

in the pathological hemoglobin of sickle cell anemia, only one of the nearly 300 amino acids of the protein's structure differs from that of normal hemoglobin, a glutamic acid being replaced by a valine; it is remarkable that such a slight alteration in a single macromolecule in the body should prove fatal to individuals with only the sickle hemoglobin. (The disease gets its name from the fact that at low oxygen tension the abnormal hemoglobin crystallizes from solution and the erythrocyte membrane then collapses to a shape resembling a sickle under the microscope.)

Here again we are getting down to the level of *molecular* morphology, but it is also possible in at least one case to relate a gross structural anomaly to a specific metabolic disfunction. This is the case of hereditary spherocytosis, in which the erythrocytes develop as spheres rather than as biconcave disks. If you have seen the Moody Science Film, "Red River of Life," you will remember the sequence showing that the biconcave disk gives the theoretically optimum combination of rapid diffusion and mechanical strength. In the presence of a specific dominant gene possessed by those suffering from spherocytosis, apparently one of the enzymes of glycolysis, enolase, is inhibited or for some other reason fails to function properly. Glycolysis is the pathway by which carbohydrate is anaerobically converted to lactic acid; enolase catalyzes the specific step in which 2-phosphoglyceric acid is converted to 2-phosphoenolpyruvic acid. This latter compound ordinarily loses its phosphate in the next step to a molecule of adenosine diphosphate (ADP), producing a molecule of adenosine triphosphate (ATP) which can provide energy to drive a variety of biochemical reactions. The erythrocytes, having no mitochondrial enzymes for oxidative metabolism, are more dependent on glycolysis for energy than are other cells of the body, and in the diseased condition have insufficient ATP to maintain the normal cell shape. The cell membrane is mechanically weaker and ruptured erythrocytes accumulate in the spleen in the disease.

There is also much interest at present in relating mental disorders to specific biochemical abnormalities, and in several cases a single gene-enzyme disfunction has been implicated. In one severe type of mental disease the amino acid phenylalanine cannot be oxidized to tyrosine because the enzyme catalyzing this step is missing or not functioning properly; as a result the phenylalanine accumulates and is de-aminated via an alternate pathway to phenylpyruvic acid, excretion of which in the urine is characteristic of the disease (oligophrenia phenylpyruvica). Greatly reduced pigmentation is also noticed in individuals suffering from this disease; the excess phenylalanine apparently inhibits the enzyme tyrosinase and thus diminishes the conversion of tyrosine to melanin. But perhaps the most fascinating, and most hopeful, fact about this disease is that it has been found possible to identify by a chemical test those apparently normal persons who are heterozygous carriers of the recessive gene for the disease: phenylalanine tolerance tests show that carriers of the gene have only about half as much active phenylalanine-oxidizing enzyme as persons who do not possess the gene.

The December issue of the *Journal* brought our membership list up to date and indicates that some of you have moved since I last heard from you. I did hear from **Keith Cressman** when he moved to Michigan State University to take up further graduate work in the Department of Soil Science but I never got around to reporting it.

I also heard some time ago from **Charles P. Wales,** 4107 Old Mt. Vernon Rd., Alexandria, Virginia, a physical chemist working in the Electrochemistry branch of the Naval Research Laboratory in Washington on alkaline storage batteries. He sent me a bibliography of papers and NRL reports on his work with these Ni-Fe, Ni-Cd, Ag-Zn, and Ag-Cd cells; he has lately been concentrating on the silver oxide positive plate and on the oxides of silver in general. He has been a member of A.S.A. since 1953 and has attended a number of local section meetings; he reported that a small group of Christians at NRL were meeting once a week for lunch together and devotions. Charles serves as a deacon at the Old Presbyterian Meeting House in Alexandria. Some of the rest of you who attend meetings of the Electrochemical Society look him up at the next meeting and get acquainted.

Edmund W. Lowe is one of our new members listed in the directory supplement. He is president of Edwal Scientific Products Corporation, 420 West 111th St., Chicago 28, Illinois. He writes that he is more active in the business end of chemistry now than in the theoretical end, manufacturing and selling a line of photographic chemicals (which my darkroom-inhabiting friends tell me are the best on the market). Dr. Lowe is in fellowship with a local assembly of Plymouth Brethren, among whom he has seen some remarkable instances of answered prayer. He hopes to be able to attend at least part of our Annual Convention, June 9-12 in Chicago. I hope the rest of you can, too!

John E. Lothers, Jr., is also a new member of our Affiliation. Jack teaches general and organic chemistry at The King's College, Briarcliff Manor, New York, and assists with a biology lab. His M.S. is in biochemistry and he hopes some day to do more graduate work in some field of biology. Jack was able to attend the 1958 Annual Convention in Ames with Wayne Frair, who teaches biology at the same school.

Another new member is **Francis D. Houghton**

of 27 Avenue E., Claymont, Delaware, who is Chief Chemist of the Claymont plant of the Colorado Fuel and Iron Corporation. He supervises the chemical laboratory and handles all sorts of chemical problems in the mill as well as development work and air pollution control. He serves on the steel industry committee of the Air Pollution Control Association. From my little ivory tower of academic life I am always amazed at the versatility shown by some industrial chemists like Fran: since graduating from M.I.T. in 1937 he has spent six years doing everything imaginable for duPont, done research for three years at Sun Oil on catalysis and other physical chemical problems, been in business for himself, filed patents on papermaking while with American Viscose, and worked on ultrasonics at Aeroprojects, Inc.! Is there anything this guy hasn't done? On the side he has developed his hobby of photography into a profitable partnership business with his sixteen year old son. He writes that although he was nominally a Christian for many years he has only recently found a deep relationship with Christ, an experience which is still fresh and exciting to him. He is a member of an Orthodox Presbyterian church, where he has just been asked to teach a boys' Sunday School class. He has been attending meetings of the Northern Delaware local section of A.S.A. and rejoices in his continuing discoveries of other professional men who are evangelical Christians.

Ernst K. Thommen, 135 N. Oakland Ave., Pasadena, California, is also a new member of A.S.A., and has also moved around quite a bit. After graduating from the Institute of Technology in Zurich, Switzerland, he specialized in wood chemistry and paper technology in Sweden, Finland, and Germany, taught chemistry briefly in Zurich, and worked for Sandoz pharmaceutical house in Basel. He then came to the U. S., did a year of graduate work at New York State U. College of Forestry in Syracuse, and went to work for Arthur D. Little, Inc., in Cambridge, Mass. Since March, 1958, he has been studying theology at Fuller Seminary and teaching physics and algebra part-time at an electronics school in Los Angeles. Ernst was kind enough to send me a reprint covering the work he did on paper manufacture at the Forest Products Research Institute in Stockholm. He is looking forward to taking part in A.S.A. activities.

Ross Donovan, Box 1175, Aurora, Ontario, Canada, does control and development work at the plant and laboratory of the Collis Leather Company in Aurora, where he is Chief Chemist. He spends a lot of his time on experimental design and analysis, making use of statistical techniques. His company has granted him a leave of absence to study biochemistry at the U. of Toronto, where in September he plans to begin work under Dr. C. S. Hanes. Ross is on the board of the Aurora Gospel Church and treasurer of its Sunday School. We welcome him into our fellowship. He is enthusiastic about the A.S.A. and looks forward to contacts with other members in the future. How about some of you fellows in the Toronto and Port Credit area starting some local activities next year?

SOCIOLOGY

Russell Heddendorf, M.A.

In continuing to view possible areas of Christianity where sociology may make contributions of a positive and practical nature, it would seem obvious to mention the mission field. Upon incomplete survey it could be pointed out that in at least two areas, sociology has a contribution to make.

Within recent years, the army has shown through a series of studies that there are certain factors which are consistent in all "fighters" whereas "non-fighters" tend to be deficient in these characteristics. Many of these variables center in concepts of home life, civilian roles and class. These studies have pointed out that the ability to adjust to crisis situations and withstand varying types of stress in a new environment largely depends upon previously developed attitudes and behavioral patterns.

It would seem that mission boards have a problem comparable to that of the army. Whereas the armed forces are concerned with maximizing the number of soldiers who actually fight in combat, the mission board attempts to increase the number of missionaries who return to the field after a first term. An interdisciplinary team composed of sociologists and psychologists might provide some knowledge which would allow for more careful selection of missionary candidates.

Anthropologists have stressed the need the missionary has of knowing the culture in order to work in it. Until such knowledge is gained or, as is often the case, if internalization of the culture should never be able to be adequately achieved, the missionary may be living in a cultural and organizational vacuum. What type of individual is best able to tolerate such a condition? Perhaps it would be possible to maintain a suitably familiar cultural climate with some form of adequate organization or community for the missionary having a low adaptive potential. In this way, such individuals could be brought more slowly into the socialization process, thereby eliminating the shock of a cultural vacuum.

The second area of study would have to do with the relationship of organization and missionary endeavor in a society. The field worker should not expect to find in other societies the same organizational ability characteristic of America. This has been clearly point-

ed out in a recent book.* What has been referred to as amoral familism tends to pervade most backward societies. The concept refers to an attitude requiring immediate concern for the individual and his family while neglecting the community and the need for mutual organization to meet its needs. In the particular society studied, religion was primarily manifest in an individualistic form with little concern for church forms. This seems a profitable point for further study since the missionary would approach a society with an individualistic form of religion in a different manner from one where there was a strong ecclesiastical organization.

Nor can the missionary neglect the effects which attempts to establish a church in an amoral familist society will have. There are mechanisms built into the church organization which seem to stimulate organizational growth in secular agencies. Study in this area should be of great profit. Religion, therefore, seems to have the property of centering the individual's interests in values and activities outside of himself and his family. This development of loyalties to phenomena outside of the immediate reference area requires the formation of organization. Though such results might be of benefit to the missionary, he should beware of an unanticipated consequence. Once an organizational mechanism is established, whether of a religious or secular nature, it may be turned to purposes other than those for which it was originally designed. History offers many examples of such displacement of ends. The reasons for them, however, are far from being understood.

Whether the missionary could ever be expected to apply such organizational information is a valid question. Nevertheless, science exists for the purpose of understanding the phenomena with which it is concerned and, for sociologists, this includes the relationship of organization and religion.

**The Moral Basis of a Backward Society*, Edward C. Banfield, Research Center in Economic Development and Cultural Change, The Free Press, Glencoe, Ill., 1958.

BOOK REVIEWS

The Physical Foundation of Biology. Walter M. Elsasser. Pergamon Press, New York, 1958. 219 pp. $4.75.

Reviewed by W. R. Hearn, Assistant Professor of Chemistry, Iowa State College.

It is no longer considered unusual for a physicist to write a book on biology, so this book is not unusual from that standpoint. The author is Professor of Theoretical Physics at the University of California at La Jolla. His approach is entirely theoretical, starting with an analysis of automota ("robots"), communication devices, and computing machines as pure mechanisms, and arguing for a non-mechanistic theory of biological systems primarily on the basis that living organisms do not appear to contain structures for information storage analogous to those of mechanical computers. He introduces the term "biotonic" for laws governing life processes which include but go beyond the mechanistic, statistical laws of physical chemistry. He rejects the cruder vitalism of the past and insists that there is no reason whatever to deny the validity of the laws of quantum mechanics in organisms; but at the very beginning he announces that he intends to reopen the old preformationist-epigeneticist controversy (See Chapter 2 of R. E. D. Clark's *Darwin: Before and After* for a brief history) on a highly sophisticated plane, and, surprisingly, that he is casting his lot with the more vitalistic epigeneticist. That is, he does not believe that the total complexity of the adult organism is "coded" mechanically in any structure within the fertilized ovum which gives rise to it.

It is difficult to decide whether or not the author has adequately justified his thesis. In the first place, the book is more electronic engineering than biology, and although the treatment is non-mathematical, the unfamiliar terminology makes the going rather slow for a biochemist or biologist. The author seems aware of this and defines and illustrates each new term carefully, but the style is ponderous and tedious—resembling that of a lawyer laboring to build a case before a jury rather than a scientific exposition. "We shall now turn to . . . ", "As indicated in the last chapter . . . ", "These questions will not be considered in detail at this time, but will be gone into later . . . ", or equivalent expressions are in such profusion as to be distracting from the argument itself.

The author omitted almost entirely any discussion of biochemistry, partly on the grounds that the specific details of metabolism are of no significance for a purely theoretical biology. This seems regrettable and may have led to some unwarranted conclusions. On p. 130 he argues against the likelihood of chemical structures being used for information storage in the cell because *in vivo* experiments show that the amino acids of protein molecules are exchanged or "turn over" at a definite rate, so the protein would therefore be subject to the degradation of its information content by random disturbances analogous to "noise". But one of the outstanding characteristics of the DNA of cell nuclei is that it does *not* seem to turn over once it has been formed—and it is the DNA that most biochemists consider to be the transmitter of hereditary information in reproduction. Of course, Elsasser's argument that there is not room enough for all the necessary information in macromolecules might be

valid anyway. Also, on page 124, the experimental basis for a one-to-one correspondence between genes and enzymes is actually much stronger than the author implies. It is more difficult for a biochemist to evaluate the arguments about the non-storage of information in the brain, which are acknowledged as being derived from Henri Bergson and to which much of the book is devoted. The point seems to be that the brain does *not* function as a highly complex computer with a memory device and a scanner to handle mechanically stored information, but functions on an entirely different principle involving reverberating sequences of pulses in an immense number of interconnecting circuits.

Anyone who defends a mechanistic view of biological phenomena should be willing to take this book seriously as a criticism of that point of view. A mechanist does not deny that life is different from non-life or that man is different from animals—he merely refuses to assume at the outset that the difference will be found to be non-physical; a vitalist does make such an assumption, but Elsasser is not a vitalist in this sense. He claims to have begun as a mechanist, pushed mechanism to its limits, and then found it inadequate for living systems, particularly for a system as complex for its size as the human brain. After all, the brain contains 10^{10} neurons, while the most complex electronic computers of the foreseeable future will hardly have a number of elementary components greater than 10^6 and they will have to be very huge indeed! In thinking about the relationship of this kind of vitalism to mechanism, the author's analogy is helpful: organismic (biotonic) dynamics may be to mechanistic process roughly as quantum mechanics is to classical physics.

To the non-physicists planning to read this book, you will probably get more out of it if you have first read something like Schrodinger's little *What Is Life?*, Gamow's chapter on "Brainy Stuff" in *Mr. Tompkins Learns the Facts of Life,* or John R. Pierce's *Electrons, Waves and Messages.* And to you physicists who plan to write another book on biology, may I humbly suggest that you take a good look at biochemistry first?

How Life Began. Irving Adler. New American Library (A Signet Key Book), New York, 1959. Paperbound, 128 pp. 35c.

Reviewed by W. R. Hearn, Assistant Professor of Chemistry, Iowa State College.

This reprint of an original hardcover edition published by the John Day Company in 1957 is a popular treatment of the nature and origin of life written for young people with little or no background in science. It presents a strictly mechanistic concept of the origin of life and also of early descriptions of the origin of life: thus the creation story in Genesis is grouped with the folk myths of Eskimos and Egyptians in which primitive man, a potter who made little animal and human statues as well as bowls and jugs, reasoned that the gods must have molded animals and men out of clay and then given them life by blowing breath into them. I suspect that this book will be distasteful to many A.S.A. members, and I confess that I read it through critically in a single evening, trying to find fault. However, I found the author's treatment to be in excellent scientific taste, and if I was disappointed at the beginning that no leeway was left for a teleological alternative I was also very pleased to see that the usual false "teleology-based-on-science" was left out at the end of the book. The only unrealistic statement of this type I found crept in on the last page after mention of the possibility of making artificial photosynthesizing systems: "Unlimited factory production of food would banish hunger forever." Who believes *that* when we already have food surpluses in this country and yet there are hungry people around the world?

I found Adler's selection of simplifications for scientific terminology generally good, as in "food makers and food takers" for autotrophs and heterotrophs, and "electron losers and electron snatchers" for reductants and oxidants (although I can't say much for "hydrogen's extra little hook" as an explanation for the formation of hydrogen bonds). After two short chapters introducing the world of living things, the story is interrupted with two chapters of fundamental chemistry (with explanations of structural formulas for organic compounds), and then the author bravely dives into the most complicated biochemical systems and their role in the origin of life. It seems quite remarkable that the young reader is effectively led in so few pages from a definition of molecules to a description of the path of carbon in photosynthesis!

In the actual presentation of scientific views of the origin of life the difference between speculation and established fact is not always clearly pointed out, but I thought the overall picture was accurately presented. A certain amount of misleading over-simplification is probably unavoidable in scientific popularizing ("So much has been learned about viruses that in 1956 chemists even succeeded in making one."), but on the whole seemed to be rather carefully excluded from this book. The brief preface commending the book to young people to give them a better understanding of the world in which they live was written by Linus Pauling.

Is this a dangerous book for Christian young people to read? It probably is if it serves as their first contact with science! If we are not willing to prepare our young people to face scientific descriptions of the world by teaching them that such descriptions are

necessary and valid but also necessarily incomplete, we will reap an increasing harvest of intellectual schizophrenia among them. We can no longer try to hide science from them or to deprecate it, but instead must help them to evaluate it from the viewpoint of their Christian philosophy. Adler's book is an honest one, and in being *strictly* mechanistic it shows all the barrenness as well as the fruitfulness of a mechanistic view of life. If science has rejected the idea of purpose and design in living things as a primitive anthropomorphism (page 11), does this mean that there is no purpose in life? Or does it merely mean that one must look elsewhere than in science to find that purpose? And how do we *know* that "the accidental mixing and combining of chemicals in the primitive sea" was *really* accidental? Accidental from *our* point of view? If so, then here is anthropomorphism no more sophisticated than that of Adler's primitive potter!

This is another book that convinces me that the A. S.A. has a real job to do in helping to make a Christian view of science a real part of Christian education, in local churches as well as in Christian colleges. Perhaps one of the most important things for us to do is to produce books on Christian philosophy for our young people, as well written as this one, and to make them as available.

LETTERS

20 April 1959

Mr. F. Alton Everest
947 Stanford Street
Santa Monica, California

Dear Sir:

I am so appreciative of the notice in the 6 April 1959 issue of the ASA Newsletter of the storm created by Dr. A. J. Bernatowicz of Hawaii concerning teleological expressions and anthropomorphic modes of thought. I will confine my remarks here to a few words, since this sort of thing could generate a thesis.

Personally, I am amused at Bernatowicz' paper and take it rather lightly, but did not do so at first reading. I do not know Bernatowicz personally but have had pleasant correspondence with him, as his specialty is also mine. I believe that his ability to generate a controversy was faithfully implanted during his predoctoral days. We both studied at the same institution and under the same man, and I know what the training was like. It was certainly "rigorous", to say the least.

The article was very well taken as far as his thesis was concerned, however, I thought I detected a vindictiveness in his tone that belied a mere passing interest or concern in the usage of "evil" terms by scientists. Could Bernatowicz have been using the article to attack any Divine explanation of origin that any scientist might hold in his mind?

For a Christian who is also a scientist the use of teleology, whether this be in the usage of expressions or as the motivation for a line of reasoning, should certainly be eliminated in his research program for if used it could definitely cloud and render inoperative the desired mechanistic causes and effects which a good basic research program should reveal. However, in contrast to many secular colleagues of mine, I hold that a man is not a scientist in the laboratory and then a theologian in the church, the two natures being widely separated. A man is a whole and to separate him would be to create a mutant sport. Therefore, it would be nothing short of impossible to completely separate teleological thinking from man's basic inner drives and motivations . According to the Bible man was created in the image of God, both regenerate and unregenerate man, and to attempt to make ourselves completely mechanistic would be to utterly frustrate our inner innate motivations, whose tendencies would be to recognize our complete helplessness in "pulling ourselves up by the bootstraps". This is no excuse to place our scientific language and research programs under a teleological approach, but as Bernatowicz expressed, a more rigorous examination of our scientific attitudes is necessary.

I want to add, however, that I doubt that Dr. Bernatowicz would enter a classroom to teach a course just full of facts and hard meat, unless he first outlined a purposeful design and plan to hang the fact on. His course would then proceed in an orderly and "teleological" manner. To do otherwise would be complete folly.

Finally, I am surprised that *Science* would devote space in their publication to this type of article. It seems to me that an article of research value of comparable space would be of more value, even if such article were to have a few inadvertent "slips of evil". It is just as evil, in my way of thinking, to harbor intolerance for one's fellow worker's nonrigorous shortcomings as it is for a very nonrigorous fellow to remain careless in the "evil" of nonrigorous sins. Who becomes the greater offender? It is well that science has good watchdogs, but perhaps the attitude becomes one similar to that of the late John L. Lewis, "I'll give the world 24 hours to get out".

Thank you very much.

Sincerely,

Ronald C. Phillips

NEW MEMBERS

Bailey, Catherine H., R.F.D. 1, Box 82, Englishtown, New Jersey, is employed by Rutgers, the State University of New Jersey as Assistant Professor in Pomology. She received a B.A. degree from Douglass College and a Ph.D. degree from Rutgers University. She also received a diploma from the Prairie Bible Institute at Alberta, Canada.

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OF INTEREST

"Jerusalem, the Divided City" J. Scofield and B. Brake. *National Geographic Magazine, 115,* 492-531 (April, 1959). Here is a pictorial description of the modern Holy City and its problems.

"The Role of Archaeology in the Study of the New Testament", M. F. Unger. *Bibliotheca Sacra, 116,* 145-155 (April-June, 1959). Usually considered as a supplement to O. T. studies, the author points out the area in which archaeology has aided our understanding of the New Testament.

"Evolution or Creation? The Heart of the Problem", R.E.D. Clark. *Christianity Today, 3,* 3-5 (May 11, 1959). A Chemistry Professor at Cambridge Technical College discusses some thoughts on this subject.

"Can God Contradict His Universe", J. Fisher. *Eternity, 10,* 26-28, (May, 1959). In a review of W. G. Pollard's book "Chance and Providence", is summarized some thoughts about miracles, laws of the universe, determinism, etc.