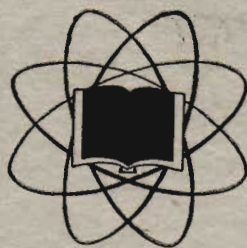


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of the

AMERICAN SCIENTIFIC AFFILIATION



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

Volume 5

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The Journal Of The American Scientific Affiliation

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EDITORIALS

PUBLICATIONS

A renewed emphasis toward spiritual values has shown itself, among other ways, in the appearance of publications devoted at least partially to that end.

The Greek magazine "Aktines" appears to be concerned with the more conservative branch of Christian life and duty. The editorials of the February, 1953 issue show in many ways a good perception of some of the practical requirements of social and international life.

Such discussions as the purely material basis of the Marshall plan with its lack of spiritual undergirding, and the emancipation of women, are presented in the editorials.

Another publication, not new but probably quite unknown to most, is one called "The Christian Graduate," published by the Inter-Varsity Fellowship in London. This magazine is evangelical in spirit, and the articles are generally of a high level. Some may be interested in the contribution in the March issue called "Sanity, Confidence and Scholarship" by a Professor Blaiklock of Auckland, with an appeal for all three in the Christian. Dr. D. C. Spanner discusses "The Methods and Limitations of Science" in this issue. Book reviews, news of other somewhat similar groups, and miscellaneous items and papers round out the contents of the publication.

A new magazine called "Popular Science Digest" made its appearance in February. Published in England by the deCourcy brothers, its "... object is to give a careful and cautious slant on Christian lines, but in a way that the reader will not be too clearly aware that there is such an implication. We want more to lead him to reach the desired conclusion for himself—the desired conclusion being the harmony of God's Word and God's Works," according to a recent letter from Mr. John deCourcy to President Mixter.

The May number will have an article based on the script of "Hidden Treasures" and the June issue one on "Dust or Destiny" the Moody Institute of Science films.

The April issue contains articles and digests under the sectional headings Medicine and Health, Electronics and Electricity, Archaeology, Interesting Industrial Processes, and Searching the Heavens, along with individual articles on such subjects as radioactivity, geriatrics, psychology, and others. Occasional illustrations enhance the readability of the digest.

NEW SECTIONS

One phase of the program to expand the interest and usefulness of the Journal has started its appearance in this issue.

It is enough of a problem to keep reasonably up to date in one's own field of training and interest without getting into outside fields. Yet it is always interesting to keep up on significant developments both in thought and experiment in the other fellow's field.

The Christian apologist has a further reason for keeping reasonably well acquainted with other fields because of his activities as a lone witness. Almost invariably in this activity critical questions are brought up in many fields, and we can hardly afford to lose opportunities while we refer the questions to experts in the various fields. Obviously, we shall not pretend

to become experts in the many lines and it is to be expected that no honest apologist shall be able to answer all questions that may come up. Yet a basic acquaintance can help tremendously in discussing many problems with the sincere inquirer.

It is with this in mind that Journal sections have been opened up, each conducted by a well-qualified expert in his field. On the part of each it means a production for every issue and therefore continuous work. It was gratifying to hear of the willingness of each, when approached on this question, to take over this task. In particular, we appreciate their efforts to open up the sections on rather short notice for this issue.

The conductors of each of these columns, we feel sure, would be glad to hear from you regarding specific topics or developments you would like to see discussed.

Four sections are opened up in this issue. Professor I. W. Knobloch of Michigan State College is managing the section on Biology, Professor F. E. Houser of Wheaton College the section on Sociology, Professor R. D. Knudsen of Rockmont College the section on Philosophy, and Karl Turekian, the section on Geology. At least two more sections will be added to the next issue.

News Notes

Dr. Francis R. Steele, who spoke at one of our Conventions, has resigned his position as Assistant Professor of Assyriology at the University of Pennsylvania to become full time Home Secretary of the North Africa Mission. Dr. Steele has been active in the Inter-Varsity Christian Fellowship as well as in other Christian endeavors.

A series of three letters by A. van der Ziel as author or co-author appeared in the **Journal of Applied Physics** 24, 222-4 (February, 1953), concerned with electrical noise in several materials and gas discharges. Another on interface impedances appeared in Vol. 24, p. 496 (April, 1953).

According to an announcement in Chemical and Engineering News, Alfred C. Eckert, Jr., has been appointed personnel administrator at the Tonawanda, N. Y. laboratories of Linde Air Products Co.

From Tom Parks, 15788 Via Arroyo, San Lorenzo, California we have the following note: "I have recently been made assistant chairman of the department of Chemistry at Stanford Research Institute. I was the chairman of the symposium on Air Pollution at the recent American Chemical Society meeting in Los Angeles, at which I was a co-author of a paper describing a new instrument for the determination of atmospheric fluorine."

Letters

P. O. Box 74,
Rossland, B.C.,
April 15th, 1953.

The Editor,
The American Scientific Affiliation
Dear Sir:

While in England towards the end of the last year I took the opportunity of calling at the office of the

Victoria Institute in London. I met Mr. Titterington, the Honorary Secretary of the Institute, to whom I passed on greetings from the American Scientific Affiliation, as requested at our last annual convention in South Dakota.

I was able to attend one of the regular meetings of the Institute. I felt that the paper presented on this occasion was of unusually high scientific quality, as also was the discussion. Unfortunately the subject was not in my field so that I was not able to follow in detail all that was said. Somewhat in contrast to the quality of the paper I was disappointed in the attendance although this was said to be better than usual. It seemed to me that the Victoria Institute shares with many organizations the difficulty of the times—when everyone is too busy. In spite of this a good work is certainly being done in having papers of high quality prepared and published. From some little discussion I had with one or two members in London I understand that efforts are being made to extend the usefulness of the Institute.

In conclusion I would like to suggest that more of our members consider joining the Victoria Institute, thus giving that body a little support, and receiving the benefit of the interesting and useful papers published.

Yours very truly,
B. P. Sutherland.

1302 Central St.,
Jackson, Miss.
April 6, 1953.

Editor,
Journal of the American Scientific Affiliation,
Dear Sir:

I am at present a subscriber to the ASA Journal, and I hope to be a member of the ASA as soon as I get my B.S. this spring.

I note with interest Dr. Howitt's article on the word "yom." If I may, I should like to call attention to some things which may be said in reply.

1. As far as I know the question is not how "Yom" should be TRANSLATED. But how it should be **interpreted**. When it is said in the second psalm that God will burst into laughter at those who rebel against Him, no one would suggest any but a literal translation, but many would not accept a literal interpretation.

2. The word "yom" does occur with a numeral when it is to be interpreted figuratively, although I confess I am not clear as to the way a numeral modifies its meaning. If you will look at Zech. 14:7 you will find that "day" is used figuratively with numeral "one". Perhaps the meaning is only altered by numerals "other than one"! It should be known too, that the expression "yom ehad" is identical with "the first day" in Genesis one.

3. Zech. 3,9-10 and Hos. 5.15-6.3 are places where the meaning of "day" can be taken figuratively.

4. The liberals do not show fundamentalist bias, it is true, in saying this means a day of 24 hours, but the bias could be shown by **insisting** upon that—in a liberal direction. However I am not charging this.

5. It is likely that Genesis one was written just when the law of the Sabbath was fresh on the minds of the Israelites, and the work days of God were set forth as an example for His chosen people.

6. From **a priori** reasoning the eternal God could hardly be expected to confine His work days to rotation of this planet.

7. Moses himself uses evening and morning figura-

tively in the 90th psalm where he says 1000 years in God's sight are but as a day (of yester) when it is past.

8. Facts of geology are as deserving of our consideration as facts of the Bible. They are just as true. And when we meet facts either of revelation or of nature that are seemingly contradictory, we must reconcile them without rejecting either.

9. I do not say that the correct interpretation of Genesis one is to say that "day" means a period time. But I believe that is a POSSIBLE interpretation.

10. R. D. Wilson allowed to "yom" the meaning of "a period of time".

I might add that I think there are several other considerations which one might hold in mind when seeking a resolution of this problem.

There **can** be a hiatus between Genesis 1.1 and 1.2 as Dr. Pusey of Oxford pointed out in the 19th century. He was Regius professor of Hebrew there. This can be whether or not one translates "hayetha" "was" or "became," the latter of which IS allowable.

Further, the "days" can have **spaces** between them, they can be of unequal length, and they need not be in the order given. These statements are made on the basis of what I believe to be allowed by the Hebrew text.

None of us know the actual truth as yet, the best we can do is to preserve a rational faith by approximating as nearly as possible a reconciliation between biblical and scientific facts that are in our hands.

Sincerely yours,
W. N. Potts

P.S. Perhaps I should not add this, but sometimes I think that the "days" COULD POSSIBLY be at times parallel as, for instance, some of the complex events in the book of Revelation are. We could then diagram them like the cross section of a cable. Of course some are not as long as others. (According to my view.)

W. N. P.

New Members

Marshall P. Welles, 1064 N. Chester Ave., Pasadena, California, is a medical missionary under the Board of Foreign Missions of the Presbyterian Church, U.S.A. He received his M.D. from Rush Medical College of the University of Chicago, and is taking further work toward the M.Sc. in the University of Pennsylvania Graduate School of Medicine.

Safara A. Witmer, 4112 Arlington Avenue, Fort Wayne, Indiana, is President of the Fort Wayne Bible College. He received the A.B. degree from Taylor University, the M.A. from Winona Lake School of Theology, and Ph.D. from the University of Chicago.

Jonathan G. Yoder, Dhamtari, M.P., India, is a medical missionary, Medical Superintendent of the Dhamtari Christian Hospital. He received the A.B. degree from Goshen College, M.D. from the Indiana University School of Medicine.

Charles W. Aman is a research chemist with the West Virginia Pulp and Paper Company, Tyrone, Pa. He received the B.A. degree in Chemistry in 1944. Home address, 621 West 14th St., Tyrone, Pa.

Howell B. Anderson, 1779 Clairmont Road, Decatur, Georgia, is a stress engineer employed by Lockheed Aircraft Corp. He holds a B.S. in A.E. from Georgia

Tech. and B.D. from Columbia Seminary.

Douglas C. Babcock is a University of Washington Fellow, where he is working for his Ph.D. degree. He received his B.S. from Wheaton in 1948, M.S. in Chemistry from Northwestern University in 1950. Home address, 9815 14th N.E., Bellevue, Wash.

Jack Gordon Blythe is a graduate student in the School of Geology, University of Oklahoma. He holds a B.A. from the University of Wichita, M.S. from Northwestern. Home address: 514 Sooner Drive, Apt. A., Norman, Okla.

Henry L. Brinks, 1856 Forest Hill Blvd., East Cleveland, Ohio is employed as a patent attorney. He received the A.B. degree from Wheaton in 1948, LL.B. from George Washington University in 1951.

Edward P. Coleson, 2125 College Ave., Huntington, Ind. is Assistant Professor of Education at Huntington College. He holds a B.S. in Ed. from Marion College, M.A. from University of Michigan, where he also has completed residence requirements for Ph.D.

Phyllis C. Cook, 424 Tyler House, East Quad, Ann Arbor, Mich. She received the B.S. in Chemistry in 1948 from Wheaton College; at present working on a National Institutes of Health Research Grant in Department of Biological Chemistry, University of Michigan.

Paul G. Culley, 630 Riverhill Circle, Columbia, S. C., is Director of the Graduate School of Missions, Columbia Bible College. He holds the A.B. and A.M. degrees from Cornell University, and received the M.D. degree from Johns Hopkins in 1925.

Thomas F. Cummings is an instructor at Westminster College, New Wilmington, Pa. He took the B.S. degree in Chemistry at Massachusetts Institute of Technology in 1947, M.S. at Case Institute of Technology in 1952.

Benjamin B. Dayton, 140 Sagamore Drive, Rochester, N. Y., is Director of Research at the Consolidated Vacuum Corporation. He holds the B.S. degree from Massachusetts Institute of Technology, and M.S. from University of Rochester.

Paul H. Fan, 6319 Brook Lea, Houston, Texas, is an Associate Professor at the University of Houston. He received the B. S. degree from Wheaton, M.S. and Ph.D. from State University of Iowa, specializing in geology.

Peter G. Fast is studying at Ball State Teachers College, will receive his M.A. degree in June. He received his B.A. from Goshen College.

Norman Frisbey, 905-C Walnut Lane, East Lansing, Mich., is working for his Ph.D. degree in Psychology at Michigan State College. He has a B.S. and M.A. from the same institution.

William K. Gowans, 781 Tennyson Ave., Trail, B.C. is an assistant Development Engineer with the Consolidated Mining and Smelting Company of Canada, Ltd. He received the B.Sc. degree in Radio Engineering in 1947 from Tri-State College.

Jessie A. Hadley (Mrs. Frank), is a housewife at R. 2, Cherry Creek, New York. She received the B.S. degree in Chemistry in 1932 from Wheaton College.

Milford Henkel II, is pastor of the Sewickley Baptist Church, Sewickley, Pa. He has a B.D. from Winona Lake School of Theology, M.A. from Boston University, M. Th. from Western Theological Seminary, and M.Ed. from University of Pittsburgh.

Clarence D. Hooley, R. 1, North Lawrence, Ohio, is Director of the laboratory at Massillon State Hospital. Goshen College granted him the B.A. in Chemistry in 1941.

Richard D. House is Instructor in Geology at Trinity Seminary and Bible College, 1726 Berneau St., Chicago. He has studied at Shelton College, Wheaton, and is now also taking graduate work at Northwestern University.

Lewis H. Humphrey, 175 S. Virgil, Los Angeles, Calif. is employed as laboratory supervisor at the Moody Institute of Science. He received B.S. degree from University of Washington, and Th.B. and Th. M. from Dallas Theological Seminary.

Celestia Jasaitis (Mrs. Zene V.), 280 Mountain Ave., Piedmont, Calif., besides being a housewife serves as National Executive Secretary of ADX, a National Social Sorority for college women who are active in Christian service. She has a B.A. degree from U.C.L.A.

Thomas Key, 7103 Casa Loma, Dallas, Texas, is teacher of biology and Junior High science in the Anahuac Public Schools. He was granted both the B.A. and M.A. degrees in 1952 at Southern Methodist University.

Harlan J. Lortz is a research chemist with Penick and Ford, Ltd., a corn wet-milling company of Cedar Rapids, Iowa. He received the B.S. from Wheaton College in 1943 and has taken graduate work at Illinois Institute of Technology.

John R. Lubansky is Professional Assistant in Pharmacology with E. R. Squibb and Sons Research Division of Mathieson Chemical Co. His home is at Como Drive, Middlebush, N. J. Received B.S. from The King's College in 1951.

Richard S. Mitchell is a graduate student and research assistant in mineralogy at the University of Michigan. He received B.S. and M.A. degrees from this school in 1950 and 1951 respectively.

Karl W. Monson, 4 Main Terrace, Perry, N. Y., is General Manager of the Perry Knitting Company. He was granted the B.S. degree in 1941 at Wheaton College.

Faye Schwitters, Steamboat Rock, Iowa, has a B.S. degree in Chemistry from Wheaton College; plans to continue her studies soon.

Roy D. Shaffer, P.O. Kijabe, Kenya Colony, East Africa, is employed by the Africa Inland Mission. He holds a B.S. degree from Wheaton College.

Raleigh J. Van Cleave, 515 W. Main St., Silverton, Oregon, is a physician engaged in private practice. After a B.S. from Wheaton College, he took M.D. from Northwestern University Medical School in 1935.

David L. Willis, 5462 Andy St., Bellflower, Calif., teaches science, mathematics and Bible at the Brethren High School, Paramount, Calif. He has Th.B. and B.A. degrees from Bible Institute of Los Angeles, B.S. from Wheaton College and is working toward M.A. from Long Beach State College.

The Contribution of Anthropology to the Understanding of Race*

JAMES O. BUSWELL III, M.A.
Assistant Professor of Anthropology
Shelton College, New York

Probably anthropology, more than any other single science, has been responsible for refining the definition of human races. Racism, or racial prejudice too, has been directly within its scope. The first authoritative spokesmen from modern science for the physical and mental equality of the various races have been anthropologists whose researches have once and for all shown the error of the old evolutionary arrangement of the modern races.

There are several important conclusions which can be reviewed at this date, which have been arrived at largely by means of the study of the ethnological and genetic data which comprise major aspects of anthropology.

First of all, the concept of primitive pure races as ancestral to the present varieties has been discarded. In evolutionary thought this concept was held by some who claimed that man evolved on different portions of the earth and finally interbred after several "pure" races had been established. In Christian circles this concept stemmed from a mistaken impression that the three sons of Noah were the founders of the three major racial groups, white, black, and yellow. In its most extreme form this belief even considered the families of Shem, Ham, and Japheth to have been made respectively yellow, black and white from the time of the dispersion from Babel.

This question has been adequately treated by Smalley and Fetzer in the second edition of the A. S. A. symposium *Modern Science and Christian Faith*, and by Horner in the first edition, so we will not pause to discuss the various aspects of the argument here.

Weidenreich points out that fossil men differed contemporaneously in a fashion analogous to the differences of modern races, stating that "It is evident from the beginning that any search for stable archetypes, whether of Negroes, Mongolians, or any of the white racial groups, will be condemned to failure. All available facts indicate that crossing is not a late human acquisition which took place only when man had reached his modern phase." He concludes that humans must have interbred ever since they began. (Weidenreich, 1946, p. 82).^{*} Boyd says of the idea of originally pure races that it shows "ignorance of the nature of the phenomena of racial variation." (Boyd, 1950, p. 193.)

Another concept that has been shown to be in error is one which is a good deal more touchy. That is, that inter-racial marriage is biologically harmful and is bound to "degenerate" the race. The sociological implications involved with interracial marriages are what cause it to be such a touchy question. There are always such gravely practical questions as, Which racial group is going to accept the mixed marriage? and What is going to be the lot of the children? which must be

considered.

The study of genetics and the study of history prove without a question of a doubt that the mixing of races cannot be considered **biologically** or culturally harmful. The anthropological position can be summed up pretty well in the words of Ruth Benedict and Gene Weltfish:

"The movements of peoples over the face of the earth inevitably produce race mixture and have produced it since before history began. No one has been able to show that this is necessarily bad. It has sometimes been a social advantage, sometimes a running sore threatening the health of the whole society. It can obviously be made a social evil, and, where it is so, sensible people will avoid contributing to it and grieve if their children make such alliances. We must live in the world as it is. But, as far as we know, there are no immutable laws of Nature that make racial intermixture harmful." (Benedict and Weltfish, 1943, in Benedict, 1945, pp. 179-180)

Weidenreich brings out the fact, in quoting Ernst Kretschmer on the effect of racial mixture on the development of Western culture, that "High cultures in their most marked form have so far developed within the sphere of the Nordic race only in those regions where that race has been exposed to an intense mixture with other races . . ." (*Geniale Menschen*, Berlin, 1929, quoted in Weidenreich, 1946, p. 90) This can be shown to be true for other major civilizations throughout history.

In view of the general consensus of scientific opinion which has predominated in this matter for a generation or more, it is sometimes startling to be brought up short by the realization of how slowly these facts percolate through the prejudices of even our most well informed citizens.*

It has also been anthropology's lot to investigate problems of racial unity and dispersion. As far back as scientific evidence goes, the original and continued unity of the human race throughout time and space is fundamental. Weidenreich, one of the foremost of the accepted paleontological authorities, even claims that "not only the living forms of mankind but also the past forms—at least those whose remains have been recovered—must be included in the same species." (Weidenreich, 1946, p. 3).

Benedict and Weltfish again, state that "The Bible story of Adam and Eve, father and mother of the whole human race, told centuries ago the same truth that science has shown today: that all peoples of the earth are a single family and have a common origin."

The dispersal of the human race from its creation to the Flood, and from Noah to the present day con-

* This paper, in condensed form, was read at the Sixth Annual Convention of the American Scientific Affiliation in New York, August 28-31, 1951.

* See complete references at end of paper.

stitutes one of the major problems of anthropological investigation.

For the Christian, the dispersal of mankind to North and South America has interesting implications for the study of the period and scope of the Flood. If there were people inhabiting America before the Flood who were destroyed by it, the length of time taken to repopulate America by normal means of dispersion from the region of the middle East would have assured the appearance of quite a distinctly different racial type, in terms of the dynamics of racial change discussed in the last two sections of this paper, from the type that had been there before the Flood. Since in all the history of American prehistoric archeology there has never been found any evidence of human beings fundamentally different in racial features from the generally Mongoloid American Indian type, it would seem to be reliably concluded that America was only populated after the Flood. This is just one example of the many problems of the prehistoric dispersion of peoples over the face of the earth.

II

Physical Anthropology has not only contributed to the investigation of racial origin and theory, but also to racial dynamics. What causes racial variation? Here anthropology joins hands with biology, geography, and genetics to form one of its many inter-disciplinary alliances for the analysis of certain problems.

According to the recognized scientific research in this area, there are several mechanisms of racial differentiation. It is hardly necessary to point out, however, that to the evolutionist, these are the mechanisms of the process of evolution, being at once the processes observed in the genes of the famous fruit fly, the causes of the variations among the species and sub-species of birds, and the explanation for the racial differentiation of mankind. These mechanisms are known collectively as speciation. G. G. Simpson writes of speciation:

"The process typical of this mode of evolution is the local differentiation of two or more groups within a more widespread population. On the smallest scale, this process involves group differences so minor and so fluctuating that they are given no taxonomic designation and have no clear evolutionary significance, although the event may prove that they are the beginning of changes that do become permanent and important. At a slightly higher level local groups attain temporary equilibrium, but the condition is not fixed or irreversible: the groups are approximately subspecies in taxonomic terms. If, or when, definite isolation of the groups occurs, there is a splitting of the population into two or more separate closed systems, which are at first species, but may be a continuation of the same sort of process and other processes become genera or somewhat higher units." (Simpson, 1944, p. 199.)

Those who are familiar with R. L. Mixter's monograph **Creation and Evolution** will recognize that this is the phenomenon under discussion when he writes:

"If the Savannah Sparrow of the mainland gives rise to the Ipswich Sparrow, living on Sable Island 100 miles off the coast of North America, evolution has occurred. But this is a very restricted use of the term. In this sense, Creationists can be called evolutionists. Any change at all of any amount, no matter how small, may be called evolution. So believing that the descendants of Adam and Eve are now members of different races is believing in evolution in this restricted sense." (Mixter, 1950, p. 2.)

Elsewhere in the literature of genetics and systema-

tics, one may find many and repeated examples of species, through one or another phase of, or combinations of phases of speciation, giving rise to groups which taxonomically may be called sub-species and new species. All this is merely to say that speciation does occur.

Four of the processes of speciation, outlined by Boyd in **Genetics and the Races of Man** are: genetic mixture, genetic mutation, natural selection, and genetic drift. We will briefly illustrate each one of these.

Genetic mixtures occur when populations of a species which, having been isolated from one another and having developed genetic differences through a number of different ways, come together and distribute or redistribute their genetic composition throughout the entire group by subsequent crossing.

Mutations are sudden alterations of particular genes or members of alternant gene pairs called alleles, which, due to their unpredictable, random, and relatively infrequent occurrence cause only very slight variation in a population except where other factors are involved and over comparatively long periods of time.

It has been widely claimed by creationists that since mutations are usually detrimental to the individual, that this could not possibly be a mechanism of evolution since evolution presupposes a change for the better, an idea incidentally of evolutionary progress which is quite unfounded in present day evolutionary theory.* Mutations are generally to the disadvantage of the individual, but not quite in the sense usually understood. One geneticist explained it this way. The organism is very highly adapted to his environment in the same way as a finely adjusted microscope. Any chance mutation like any chance turn of the adjustment knob would be more than likely to destroy the adaptation or adjustment. We will return to our illustration presently.

The next mechanism, natural selection, is the one most famous or should we say notorious for its implications for Christianity. Advanced as the most important cause or mechanism of evolution by Darwin it has been used and misused ever since.

Let us go back for a moment to our illustration of the microscope. The detrimental effect of a mutation is the usual thing, if, indeed it is not completely unadaptive, making no difference to the organism whether it occurred or not. However, in our illustration of the microscope we were presuming that the slide which we are examining is held stationary by the clips. Should the slide be lifted slightly at one corner, there would now be a fifty fifty chance of a turn of the knob being in the direction of a proper re-adjustment. If we realize that a well adapted organism is in a **changing environment**, and that the rate of change is seldom constant, we can see clearly how, for example, a mutation and resulting manifestation of the gene involved might easily cause the individual to be more poorly adapted to the environment of its immediate ancestors but, passed on to its progeny, result in their being much better adapted to a changed environment within several generations.

There has been a strain of sheep carefully bred and selected for their extremely short legs by shepherds who realized an advantage in their sheep's not being able to jump the fences. Such a strain originated on two separate occasions when through mutation, a sheep was born with quite unusually short legs. This characteristic was preserved by artificial selection.

At a very early date in prehistory, Eohippus, the

earliest fossil horse known, was well adapted to an environment and dietary conditions which included browsing habits, and seeking food among brush and shrubs. The story can be correlated almost precisely with the findings of the paleobotanist, that following this particular period, the ecology of the regions in North America inhabited by Eohippus and later fossil horses, underwent a gradual change, resulting in the description of vast stretches of plains and the coming of grasslands. During the same period the horse underwent changes too as indicated by well preserved fossils from these horizons. What kind of changes were they? Their teeth structure changed so that the animal was better adapted for grazing. The feet changed so that the animal was better adapted for running. These and other changes occurred during an extremely long period of environmental alteration. Mixer reemphasizes Simpson's statement of the gradualness of these changes: "Simpson says, 'if the change in any one character from Hyracotherium to Equus is divided into 300 steps, these steps are imperceptibly small and are incomparably less than the amount of intragroup variation at any one time.' Therefore the modern horse appears to have ascended from Eohippus by gradual changes no greater than those accounting for genetic differences within a species." (Simpson, 1944, p. 46, quoted in Mixer, 1950, p. 22.)

This is natural selection.

Needless to say such processes have been operative in mankind but not to the same degree.

Man's chin has changed; his brow ridges have changed; the thickness of his cranial bones has changed; other features of a noticeable and probably of an unnoticeable sort have changed. Yet the evolutionary implications commonly accompanying a discussion of speciation and natural selection need never darken the mind of a Christian student of these marvelous aspects of God's Creation.

Drastic, periodic reduction in numbers has been observed in various populations of fish and land animals. (Boyd, 1950, p. 156). Geneticists have observed that when a population numbers very few individuals, there is a much greater chance of having a gene entirely lost within a few or even one generation. This is the fourth agency which may be responsible for a change in gene frequency within a population, hence disturbing the finely balanced environmental adaptation, if only a trifle, and becoming one of the factors in racial differentiation. In this regard Boyd states of genetic drift, the chance fluctuation in gene frequencies with succeeding generations (particularly in a small population) will often result in a gene being lost. A subdivision of species into isolated populations, plus time to allow a sufficient number of generations to elapse (the number of generations being a function of the population size), is all that is necessary for race formation." (Boyd, 1950, p. 155.)

Incidentally, such a population reduction with its resulting possibility of genetic drift, coupled with an increased rate of mutation and marked ecological change, constitutes a chief evolutionary explanation for the supposed descent of one major taxonomic category from its forebears throughout prehistoric time. This genetically and ecologically dynamic situation is constructed as a projection of known experimental facts, to a point which has no basis in the paleontological record. It is at this point that the Creationist must offer an alternate conclusion from the facts whereas, at a more nearly experimental level, or one at which lower taxonomic categories are being discussed, the

Creationist should have no objection to the findings of the sciences of genetics and paleontology.

III

There is current in the field of physical anthropology a rather marked trend away from reliance completely upon the traditional racial characteristics arrived at by measurement and description, toward a healthy appreciation for the contributions of the genetic approach. There still remain however, many who condemn the new approach as inadequate and naive. Chandler W. Rowe for example, criticizes Boyd rather strongly regarding some supposed fallacies in Boyd's argument. He says that "Boyd would discount as useless those physical characteristics which are used today for racial classification. By what means, and with what factors would he classify Man into 'races'? Of primary importance he feels, are the known blood groups since 'blood groups are characteristics genetically determined by known mechanism, absolutely objective in character, absolutely unaffected by environment, not subject to mutation at any rapid rate and, so far as we are able to discover by extensive investigation, non-adaptive.' (Boyd, 1940, p. 447.) What Boyd is doing here is using only one criterion for racial classification . . . " (Rowe, 1950, p. 199.)

Rowe then shows the difficulty of such a view as, for example, that such a classification would result very frequently in the assigning of members of a single family into different races. Rowe concludes at one point by saying that "Any attempt therefore, to assign the members of the human population to positions . . . in races on the basis of genotypes must, for the present, at least, meet with failure." (Rowe, 1950, p. 209.)

Boyd, however, does not make exactly these claims. I believe Rowe quotes him quite out of context. Since Boyd is one of the outstanding protagonists of the Genetic approach to physical anthropology, it would be well to point out that he does not insist upon the use of the single criterion of blood groups for individual classification, but rather speaks in terms of "differences in frequencies of the four groups among various populations . . . " which resulting classification "**happens to correspond with geography**" (Boyd, 1950, p. 269). "Striking differences in certain gene frequencies mark off the inhabitants of the various continents." (Boyd, 1950, p. 270.) Furthermore Boyd emphasizes specifically: "It must not be supposed that the genetic definition of race would naturally be 'a group of individuals with identical genetic constitutions. This would **not** be a good definition . . . for groups of identical individuals are simply never found . . . ' (Boyd, 1950, p. 201.) He indicates further, "that it would be equally fallacious to define a race as a group of individuals having some single gene in common or some chromosome structure in common. Since so many variable genes and chromosome structures exist and since these different genes and chromosome structures can form a large variety of combinations, we should be certain to find individuals classified as belonging to one race insofar as some gene, say F, was concerned, but who would belong to a different race in regard to the gene G, and a still different race in regard to the gene H. A race' Boyd goes on to define, 'is not an individual and it is not a single genotype, but it is a group of individuals, more or less from the same geographical area (a population), usually with a number of identical genes, but in which many different types may occur.'" (Boyd, 1950, p. 202.) The genetic approach does not, then, base its case upon the observation of individual

genetic composition but upon 'geographically differentiated' populations which 'differ in regard to the relative frequencies of chromosome types (and genes).' Boyd says that ' . . . this is exactly what the geneticist means by racial differentiation.' (Boyd, 1950, p. 205.)

It will be apparent from the example of controversy and slight misunderstanding surrounding the analysis and definition of this one phase of the matter, that it will be some time before the difficulties from the encroachment of the genetic point of view upon the anthropometric tradition are resolved. Nevertheless great strides are being made in that direction. Joint symposia are being held and the sharp controversies seem to be gradually giving way before an attitude of the necessity of cooperation for further advance.

Discussion

Mr. James Buswell: The question has been asked if we could discuss a little more fully the fact that anthropology would conclude that the black, yellow and white races of mankind did not stem from the sons of Noah—Shem, Ham and Japheth—directly.

Point No. 1—Obviously Shem, Ham and Japheth were presumably of the same skin color as their father, Noah.

Secondly, and perhaps more important, their dispersion, as recorded in Genesis, does not correspond to the traditional central locations of the three racial groups, yellow, black, and white.

Thirdly, a point which is more widely controversial but somewhat more easily settled, however, is the account of the curse of Noah upon Canaan, the son of Ham, and upon his descendants. Even though the curse said that Ham should be a servant, the argument that this had to do with the present negro race as a slave race throughout the world is very speculative indeed. I cannot go into the explanation of that part here but many biblical scholars have pointed out that the curse on Canaan was fulfilled at a subsequent annihilation or defeat of his progeny and did not have anything to do with people of the negro race of today.

Of course, there also are various details regarding Ham which have to do with the Ethiopian progeny of Ham having burned skin, being black, and so forth. But the people of the Ethiopian portion of Africa are not negroes. They are of another race by most classifications, morphological and otherwise.

To give an ultimate explanation of where the three

racess did originate from would be going pretty much into detail. It is a matter of geographic isolation, genetic mutation, in-breeding, and a slow, morphological changing and adapting to environment, complicated with many other factors plus a subsequent dispersion and redistribution of genetic materials in a complex of population movements.

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FOOTNOTES

* One recent example of this is particularly interesting because of the attempt to put interracial marriage in bad company by calling it a "philosophy inspired by Moscow." Georgia State Representative David C. Jones and state Senator John D. Shepard have been quoted as planning to introduce legislation to forbid the presentation of entertainments, musicals, and the like which in any way advocate such subversive practice. They even go so far as to say "Inter-marriage produces halfbreeds, and halfbreeds are not conducive to the higher type of society. We in the South are a proud and progressive people. Halfbreeds cannot be proud. In the South we have pure blood lines and we intend to keep it that way." (*New York Times*, Sunday, March 1, 1953.)

* See for example Simpson's chapter on "Progress in Evolution" in his *The Meaning of Evolution*.

The Spheres of Revelation and Science --- What Are Their Limitations In Relation to Each Other

R. E. D. CLARK, M.A., Ph.D.

EDITOR'S NOTE: Among the articles published in the Journal it is planned to include an occasional reprint from the *Transactions of the Victoria Institute*. The Transactions are not readily available to many of our readers. By these reprints we hope to bring to a wider audience some excellent material as well as to gain an acquaintance with our brethren in other countries and their works. Permission to reprint has been granted by the Victoria Institute through the efforts of Dr. Brian P. Sutherland.

This article by Dr. Clark is the Gunning Prize Essay for 1946 and appears in the *Transactions*, Volume 79, pages 138-166 (1947) including discussions.

I

In the middle ages knowledge was a unity. Every branch of science was interpreted in terms of Theology, the queen of sciences. Free speculation was, indeed, allowed but only on condition that hypotheses that did not fit into the general framework were to be regarded as amusing pastimes rather than as sober truth. Men were free to work out the consequences of a heliocentric system in astronomy if they wished to do so but they were not free to say that the heliocentric system was true and the geocentric false. To adopt such an attitude was to set oneself up against the teaching of learned theologians and was therefore an indefensible act of pride. The task of the investigator was to invent hypotheses to "save appearances" (*salvare apparen-tias*), that is to say to cover the observed facts adequately, not to provide explanations of the nature of things (*in esse et secundum rem*).

Modern science was born when men like Bruno and Galileo boldly asserted that their hypotheses were not mere speculations but that their studies were actually leading to ultimate truth. It was this claim that at once produced friction with the church. In addition, the church has always stood for a policy of secrecy. Speculations, even if they were not asserted to be true, could be published only for the benefit of learned men. Attempts to bring them to the attention of the masses were forbidden lest they should prove dangerous in undermining the church's authority. Much of the early friction between science and religion was caused by the fact that men of science had the temerity to assert, not only that experiments and observations could lead men to truth, but that truth, once discovered, was to be made available for all.

As Sir Henry Dale has pointed out,¹ the fact that science won one of its first great battles against the policy of secrecy, is not irrelevant to the situation in our modern world. Today, as in time past, we find that certain scientific ideas are regarded as dangerous by the politicians, so that there is once again a determined effort to reimpose secrecy. What the outcome of the present struggle will be we do not yet know, but many leading men of science are reaching the conclusion that the welfare of science is once again at stake.

We have seen that, until the beginning of the modern era, theology had everything her own way. She knew no limitations. She claimed an absolute right to insist that the view-points in all other subjects should be so adjusted that nothing should conflict with the dictates

of the Church. Science, on the other hand, had no real freedom. The man of learning was free to speculate for the sake of speculation alone, he was not at liberty to claim that his speculations corresponded with reality unless they were also in agreement with the doctrines of the church.

Into this world the scientific renaissance introduced what must then have appeared to be as a fundamentally new approach to knowledge. Our outlook has now altered so greatly that it is difficult to realise the degree of originality involved.

When, today, we begin the study of a new branch of knowledge we often try to examine the facts before us in what we call an "unprejudiced" way. By this we mean that we must make a deliberate attempt not to carry over from our previous studies a large number of preconceived notions into which the facts can only be made to fit with the aid of a good deal of "special pleading." Rather than "teach" nature how to work, we try to let nature "teach" us.

This attitude has become thoroughly ingrained in our manner of thinking. Even among people who profess no academic outlook, it has become almost proverbial to say that facts are more important than theories, which is, of course, an expression of the same idea.

When we examine the matter in further detail, we find that there have been several phases in the development of the new approach. In their early days the various sciences developed more or less independently. The fundamental ideas of mechanics, of magnetism, of electricity, and of chemistry were each chosen in such a manner as to make the actual facts of these respective sciences as intelligible as possible. It did not matter if, for instance, the attraction of magnets for pieces of iron, or of the earth for the moon, seemed unconnected with the attraction of hydrogen for oxygen. Forces of attraction and repulsion, ethers to convey these forces, magnetic poles, electric charges, unconnected units of mass, length and time, new types of valency binding atoms together, and many other things, were simply invented *ad hoc* as and when required and their appropriate laws were then determined. In this early phase, little or no attempt was made to prevent the multiplication of arbitrary starting points for scientific explanation. A scientific worker was free to postulate a magnetic pole simply because the properties of magnets could best be described in terms of such poles: he did not come to the study of magnetism imbued with the principles of mechanics and determined, at all costs, to explain the force between two magnets in terms of a rate of change of momentum.

At a later stage a reaction set in. By the middle of the nineteenth century it was recognized, wisely, that if new principles of explanation were allowed to multiply indefinitely, science would, in the end, cease to explain anything at all. In consequence it came to be regarded as highly unorthodox to introduce even one new entity or principle of explanation. It was implicitly assumed that the first investigators of science had

discovered all the basic principles that could possibly exist and any innovator who tried to introduce another was at once met with the well-worn Latin tag: "*Entia non sunt multiplicanda praeter necessitatem*" (entities must not be multiplied beyond necessity)—the principle usually referred to as "Occam's razor".

But entities had already been multiplied beyond necessity—beyond necessity, at any rate, in the light of later scientific developments. As science advanced, the various pigeon-holed ideas upon which it had been founded were extended in various directions and, at length, inevitably, the different branches of science began to impinge upon one another's spheres of interest.

The results of this "clash" between the sciences are now well known.² The propagation of light could only be explained by supposing that light consisted of vibrations in an ether which had a density of a million million times that of water and a rigidity much greater than that of steel. Magnetism also required an ether, but this ether had to be pictured as capable of streaming along tubes of force and so was entirely devoid of rigidity. It is hardly necessary to discuss the subsequent history of these theories here. The important point is that, at first, the various branches of knowledge, each making use of concepts invented for its own benefit alone, led to contradictory results as the various lines of enquiry were independently pursued. What happened at the end of the 19th century, was only an example of what has happened many times, both before and since, and of what is, in fact, still happening.

In a sense the "clash" between the sciences is closely parallel to the "clash" between science and religion. As Professor Dingle has ably urged,³ the languages of modern science and of religion are both attempts to describe and explain our experiences in the terms which seem most appropriate to the study at hand—sense data and religious experience. It is not likely, therefore, that when these studies are pursued, borderline cases will be discovered in which, at first sight, disagreement is apparent. Such disagreements become possible when religious and scientific explanations of the early ages of the world, of apparent recorded miracles, of unusual events involving the minds of men (e.g., the conversion of St. Paul), and put forward from the two different points of view.

However, just as the disagreement, between the various sciences, has often been reconciled by subsequent, and more extended examination, so the religiously minded person has usually felt that, if all the facts were known, no disagreement between science and religion would ultimately remain. The doctrine that such an inconsistency is ultimately inconceivable, has, indeed, received a great deal of support from the surprising, and indeed wonderful, way in which unification between some of the sciences has already been effected. It is this fact which, to many minds, makes the "modernist" approach to the Bible seem unreasonable. The "modernist" theologian gives the impression that whenever he finds an apparent inconsistency he feels that it is the duty of the religious part of him to retreat. If the religious explanations of the early ages of the world or of the psychology of the religious life clash with the best conjectures of present day science—well, it is taken as a sure sign that religion, and not science, is transcending its proper limits. The Christian is told that he must be humble enough to admit that he has used his religious concepts in a sphere to which they cannot be applied. But if theology and science

are both attempts to describe and explain experiences, why should religious explanations alone be confined rigidly to their own field? If disagreements result—need they disconcert us more than do the numerous disagreements between different branches of science? How does the "modernist" come by his mysterious conviction that further knowledge will not result in perfect reconciliation?

II

Thus the development of the physical sciences in reality gave rise to two schools of thought—only it chanced that the two schools were not contemporaneous but historically separated. First of all there were those who insisted that, when a new subject was being studied, it was legitimate to allow the subject itself to dictate what ultimate units of thought would have to be used in its development. Later, as the principle of "Occam's razor" came to be ruthlessly applied this policy was reversed. Instead of inventing new entities, desperate attempts were now made to explain the new in terms of the old.

Both these points of view had their influence upon the newer non-exact sciences—but here the two schools of thought have for long existed side by side. As we shall have to refer to them frequently, we shall, for want of better terms, refer to them as the **mechanistic** and the **ad hoc** points of view respectively.

According to the first, or **mechanistic** view, biology, being a complex subject, can only be understood in terms of the simpler ideas of physics and chemistry. The biologist has no right to invent **ad hoc** categories of thought to explain phenomena in which he happens to be particularly interested. This point of view was, of course, that adopted by the naive materialist for whom man was simply a machine, complex perhaps, but a machine for all that.

According to the second or **ad hoc** point of view the biologist has perfect freedom to introduce whatever fundamental principles will best explain the facts with which he has to deal. The right to do this has, of course, been claimed since early times—we find it in Aristotle's **entelechy**, in all classical systems of logic and ethics and, in our own age, we see its influence in the form of the various life forces, instincts, etc., which have been postulated times without number.

In the earlier part of the present century there was a tendency for the more unemotional and disciplined thinker to show an active dislike of the **ad hoc** point of view. It was claimed, and claimed rightly, that it tended towards undisciplined thought. It was always easy enough to postulate a psychic entity arranging molecules in the body, to explain sleep by a dormative principle or to dismiss conduct in terms of instincts, but how could such unbridled speculation be subjected to any tests whatsoever? Were not all these supposed explanations mere verbal ways of restating the original facts in polysyllabic words? If physics and chemistry cannot yet explain the obvious facts of biology which call aloud for explanation, may this not simply be because the latter science is still in its infancy?⁴

Despite the cogency of these objections, there have always been many biologists who were prepared to ignore them and recent developments in the physical sciences have, apparently, greatly strengthened their position. Today it is at last possible to see the early development of science in its historical perspective. We can now appreciate how the various physical sciences, leading to different and apparently inconsistent sets of fundamental ideas, have been combined by the principle of relativity. Magnetic forces, postulated to

explain the phenomena associated with magnetism, are now seen to be a property of electricity in motion. Chemical affinity, invented to explain the combination of chemical elements, turns out to be none other than the familiar force associated with the interaction of electric charges. Statistical mechanics have shown that the two concepts of **amount of heat** and **temperature** can be derived from the ordinary laws of mechanics.

In these and numerous other instances we see how different sciences have created their own concepts and have developed the laws of connection between them. In the first place the concepts were of an **ad hoc** character, but, in time, they were seen to be consequences of other and more fundamental branches of knowledge.

Facts of this kind have naturally encouraged the biologist to do what has already been done so successfully in other fields. Accordingly, he is today more inconsistent than ever before that he has a right to choose the concepts which he finds most convenient in his work and to leave to future scientific workers the task of reconciling his newly invented concepts with the established principles of science.

Thus **ad hoc** science has received a new lease of life. As examples of its development we may cite the psychology of Freud, with its welter of **ad hoc** concepts (**unconscious mind**, **ego**, **id**, **libido**, **complexes**, etc.); the idea of **gestalt** in experimental psychology around which a vast literature has already grown up (Thorndike, E. S. Russell, Kohler, Koffka, etc.); the **entelechy** of Driesch postulated to explain the development of the embryo, the idea of **organism as a whole** developed by J. S. Haldane and of **teleology** in nature (to be taken as existing alone without any implication of a plan or mind at the back of nature) sponsored by L. J. Henderson. Finally, mention should be made of the idea of **evolution** which also cannot at present be correlated with non-biological principles.

In these and many other instances we find that men of science have boldly invented **ad hoc** concepts and have attempted, with varying degrees of success, to discover the laws connecting them with one another. But in nearly every case they have been content to shelve fundamental questions as to the nature of the new concepts which have been so easily, and often uncritically, introduced.

The new drift towards **ad hoc** science has naturally produced a corresponding philosophy. In this connection the **holism** of General Smuts and more especially important still the **emergent evolution** of Lloyd Morgan must here be mentioned. According to the last named theory we must conceive of nature as a series of hierarchies. The lowest level is that of atomic nuclei and electrons. These produce atoms, these molecules and these crystals. "Liquid crystals," complex liquid, fat and carbohydrate molecules and, finally, living matter, form yet further representatives of organisation levels. Living matter itself, starting with the most simple forms and passing upward until we reach the mind of man, provides the more developed subdivisions of the hierarchy. At each level, so we are told, scientific laws appropriate to that level may be found. Some of these laws, so Morgan says, are deducible from the laws of matter found to hold at a lower level, but many are not and then the laws can only be discovered at the levels, or on levels still higher than those in which they begin to operate.⁵

In the so-called philosophy of dialectical materialism we find a closely similar attitude. Engels and Lenin had no patience with traditional materialism.⁶ They

claimed that when a physical quantity (heat, light, complexity, etc.) is gradually increased in a system, there must come a time when a new and unpredictable phenomenon is suddenly encountered. This is, of course, a statement of the Hegelian law that "quantity turns into quality" and on this view life is simply a property of chemical molecules which have a certain degree of complexity.

III

We have now considered two of the three possible attitudes which a scientific worker may adopt towards a new branch of study. When we ask questions about the limitations of science, it is obvious that we must first of all possess clear ideas as to what we mean by "science". If, on the one hand, our approach is primarily mechanistic, we shall very soon find that science is faced with limitations when it seeks to advance into new fields of investigation. Not only will limitations of a purely practical kind be encountered immediately—for our science may be at too early a stage of development to enable it to deal with complex phenomena—but there will also be the much more fundamental difficulty that it will be unable to deal with sets of ideas of an unfamiliar character.

If, on the other hand, we are always prepared to adopt the **ad hoc** approach in science, it is clear that our science can know no limitations whatsoever. No matter with what phenomena we are dealing, it will always be possible to invent suitable categories of thought for the sole purpose of describing these phenomena and, if we can find (or think we can find) relations of any kind between the concepts so facetiously invented—well, they constitute the embryonic form of a developing science. Clearly even religion is not immune from such treatment. The old mechanistic science was disposed to argue away the existence of spiritual values, the newer **ad hoc** science is simply prepared to accept them at their face value.

We must now consider briefly a third attitude which we may adopt towards a new line of scientific enquiry—the attitude implied by the word **positivism**.

According to the doctrine known as **positivism**, we can never know the real world behind appearances. All we should do, therefore, is to confine our attention to the things that we do know, the **sensa** of experience. It is useless, in physics, to try to find out anything about the ether, so we must express all our facts in the form that observers would see them and this involves giving up the idea of a velocity of an electromagnetic wave with respect to the ether. Similarly we cannot know, because we cannot determine, the precise position or velocity of a small particle so we must express ourselves only in terms of probabilities which, by taking a sufficient number of observations, can actually be measured.

Positivism has long had a certain vogue but the new developments in physics—though they have hardly tended to revive Mach's thoroughgoing scientific positivism—have had interesting repercussions on anti-theological thought. Many writers and thinkers are beginning to state quite blatantly that since man cannot reach the ultimate truth about things, spiritual values must just be accepted as we find them without asking any questions as to where they come from or how they arise. Olaf Stapledon,⁷ for instance, compares these values to the primitive beliefs about the stability of the earth. We can accept the earth, he says, without having to believe that it rests upon the back of a tortoise which is, in turn, squatting on the back of another tortoise and so **ad infinitum**. So why not accept spiritual

values without asking questions as to their origin?

Precisely the same point of view has been put forward repeatedly with regard to the universe.⁸ If we follow the tradition of positivism it becomes quite illegitimate to ask where the universe came from or how it was created. The only relevant fact is that the universe is here, so that there is no need to ask where it came from. In the same way teleology in nature can be accepted without attempting to account for its origin.

In recent years even right and wrong have been defined in terms of their influence upon evolutionary progress—a right course of action being of assistance to evolution and *vice versa*.⁹ In this way the unobservable principles of right and wrong can be eliminated and in their place we are simply left with observable (or potentially observable) effects on evolution.

For the same reason it is often asserted¹⁰ that the old discussions about mind and body are now completely out of date. No longer is it necessary to ask whether scientific evidence supports the view that mind is a spiritual entity inhabiting a material body, for from the modern point of view such a question is completely meaningless. Positivist science must confine itself to tangible things: the phenomenon of mind is definite enough but it is unscientific to invoke intangible souls and spirits which may prove to have no more objective existence than the 19th century ether. To ask questions about discarnate minds is to come to nature with preconceived ideas whereas the true investigator should keep his mind open and be prepared to learn from nature, not to force nature to conform to prearranged grooves of thought. "The chances are thousands to one that all our most carefully conceived ideas on these subjects are more false than true."¹¹

IV

From this discussion it will be seen that the *ad hoc* and the *positivist* attitudes towards science may both serve for the repudiation of theological ideas and, in point of fact, we often find that the two attitudes are held together in a single person's mind while both are supposed to represent the culmination of 20th century scientific thought. But, for all this, they are strange bed-fellows as we shall shortly see. The only real agreement between them lies in the fact that both of them enable people to avoid all discussion of the old problems of science and religion. Souls, discarnate spirits, freewill and the Deity Himself are unnecessary postulates if we are at liberty to invent *ad hoc* causative principles which operate only at the levels of organisation at which they are invoked. They are equally objectionable if it is the duty of the scientist to keep his science free from unobservables.

Nevertheless, despite the superficial agreement, the *ad hoc* and *positivist* attitudes are really mutually contradictory. This is at once obvious when we reflect that such ideas as *unconscious mind*, *psychological complex*, *evolution*, and many other similar concepts refer to things which are unobservable and should therefore be repugnant to the positivist. It is difficult indeed to resist the conviction that many modern writers use which ever of the two attitudes best serves the purpose of the moment when they wish to discredit theology. Professor J. D. Bernal's remark to the effect that "the invocation of God—just because it can be done when faced with any intellectual or moral difficulty whatever removed any necessity for a rational treatment of the world"¹² is every bit as much criticism of *ad hoc* science as of theology. Yet the *ad hoc* scientist often thoughtlessly repeats the criticism.

JUNE, 1953

V

We have seen that both *ad hoc* and positivist science are all-inclusive schemes of thought which by their very nature can know no limitations in respect of theology or of any other branch of study. The first invokes new principles as required, in order to explain phenomena in complex cases and in this way it succeeds in avoiding ultimate issues. The pious hope that a future Einstein will one day discover the fundamental relations between the new ideas and the old is a hope only and, as we shall shortly see, it is a hope that can never be realised. **Positivism**, on the other hand, avoids the asking of fundamental questions by the simple expedient of denying that they are of any interest and insisting that attention should be focused entirely on the things of sense. It is all-inclusive because it denies the existence of theology.¹³

The deficiencies of these types of science are such that we may well ask why they have become so popular, seeing that neither of them really achieves the most fundamental aim of science—the satisfaction of human curiosity.

The reason is probably to be sought along the following lines. In the present century mechanistic science has reached an *impasse*—a fact freely admitted by nearly everyone today. The early hope of the materialist that mechanistic science would prove all-embracing has turned out to be false for its limitations have become obvious in a number of directions. The discoveries of the past twenty years have, in fact, made it practically impossible to conceive that any possible modification of the old science will enable it to explain all phenomena.

In this connection the work on the brain initiated by Lashley is particularly relevant. At one time it seemed possible to conceive of the brain as an enormously complex telephone exchange. Experiences made more or less permanent connections between the "wires," thus setting up "conditioned reflexes". Today this view is universally considered to be quite untenable. If memory is dependent upon connections between nerve fibres then, when the brain is partly destroyed, the fibres connected with a particular reflex, should either be disconnected or not disconnected. Now if a rat learns how to extricate itself from a particular maze, and a part of its brain is then destroyed, the memory loss is found to be dependent upon the **amount** of destruction and **not** upon the position of that destruction. Again, in man, there is only one part of the brain in which there is a rigid point to point connection between sensory fibres and the cells of the brain, and that is in the occipital region, the cells of which are individually connected with the rods and cones of the retina. Yet, even here, when a squint develops, or when one half of the retina is destroyed, the mind can reorganize the entire meaning of the impulses which reach the brain, despite the fact that the physical connections remain unaltered.

Facts of this kind, to which we should add the experimental proof of telepathy in recent years, show only too clearly that mechanistic thought is unlikely ever to explain even the simplest mental phenomenon, let alone the existence of spiritual values or the sense of right and wrong. Bearing in mind the long history of enmity between science and religion that was stirred up in the latter part of the 19th century, it is natural enough that rationalistic scientists of today have abandoned mechanistic science which, by its very failure, obviously opens the door widely for the entry of theological ideas. It is no wonder that the *ad hoc*

and even the positivist attitudes to science have found favor.

We must never forget, however, that in extending its scope in these ways, science is weakening its powers. **Ad hoc** hypotheses become increasingly of a purely verbal kind, affording no real understanding of the factors involved. Moreover, from the point of view of the traditionalist the new attitude is simply a case of special pleading. Instead of trying to find out whether such entities as minds do in fact exist apart from matter, it is pretended that all such questions are meaningless, whereas they are actually assumed to be untrue. The new attitude of empiricism is not what it professes to be—an attempt to let nature “teach” us. The **ad hoc** scientist is at least as guilty of coming to nature with his mind already made up as ever the traditionalist was.

VI

In the preceding sections we have examined, mainly without comment, arguments which can be brought forward in favour of the **ad hoc** and **positivist** attitudes in science. Since a study of the limitations of science is so largely bound up with the type of science under consideration, it will not be out of place if at this point some brief comments upon these arguments are introduced.

We saw in the first place that the **ad hoc** attitude can be justified by an appeal to the early history of physical science. Here **ad hoc** concepts have often ultimately become absorbed into the main body of knowledge and, in any case, progress would have been impossible without them. How far is this analogy justified?

First of all it should be said, at once, that physics itself has not been unified to the extent that is commonly imagined. It is still impossible to understand how gravitational forces are related to magnetic and electric forces. Even when we come to those branches of physics which have been unified by relativity, it is important to notice that the unification is numerical only. The history of science shows how relatively easy it may be to get numerically correct results on the strength of false premises—the ancients were able to calculate the speeds of rotations of the heavenly spheres which were supposed to carry the stars and by this means they were able to predict astronomical phenomena successfully. In modern times, as O’Rahilly¹⁴ has reminded us, the mathematical equations of modern electromagnetic theory can be derived from quite a variety of mutually inconsistent starting premises. By way of example it is well known that both corpuscular and non-corpuscular theories of electricity give rise to the same equations of flow when a relatively large amount of electricity is under consideration.

Physical science sometimes deals with concepts which are so far removed from everyday life and so difficult to correlate with one another, that the attention of the physicist is often devoted, not towards effecting a true unification of ideas, but towards achieving numerical agreement only. This is particularly the case in the well-known method of **dimensional analysis**. In this, after a physical phenomenon has proved too difficult for analysis, a mathematical method shows how its **magnitude** may be expected to vary when a change is made in the magnitudes of the various physical factors with which it is supposed to be connected. Remarkable numerical predictions are thus obtained but the agreement throws little light upon **how** the phenomenon in question occurs. For instance, we may discover by dimensional analysis, that the drag on a

ship moving through the sea will vary with the square of its velocity but we may still be in the dark as to why there is any drag at all. Only in a very Pickwickian sense can it be said that a problem solved by a dimensional method is a true unification of science.

Now relativity is a special case of dimensional analysis.¹⁵ It ignores the true physical connections between various branches of science but, by a mathematical device, it shows how correct magnitudes of physical quantities can be calculated. This is the true significance of Einstein’s achievement and, looking at the matter from this point of view, we can at once see how foolish it is to suppose that the theory of relativity will ever have its counterpart in biology. Few, indeed, of the new **ad hoc** ideas of the inexact sciences provide us with anything that can be measured and so it becomes impossible to understand how any future investigator will ever be able to side-track the scientific connections between them and the older science, and confine his attention to measurements.

Of course, all this is no argument against **ad hoc** science as such. It would certainly appear that an **ad hoc** approach to reality is often necessary, and indeed unavoidable, though some will prefer not to use the word “science” in connection with knowledge obtained in this way. At all events, if we build up a system of knowledge based upon **ad hoc** ideas, we must learn to recognise it for what it really is—a mere gleam of light in an all-prevailing darkness. Moreover, we must never forget that if knowledge gained by the **ad hoc** method is to be dignified by the term “science”, then we also have every right to speak of theology as a science, for theology also demands that we should recognise and use a set of concepts suited to its own field.

It is profitless, of course, to debate the meaning of mere words: the important point is that if we use the word **science** to cover the inexact as well as the exact sciences, we must remember that the meaning of the word is not the same in the two cases.

Nowhere, perhaps, can this difference in the meaning of common words be better illustrated than in connection with the study of causation.¹⁶ Let us suppose that a physical experiment which involves, shall we say, the flow of a liquid through a tube, is carried out in the laboratory. A mathematical analysis indicates that the flow should take place at a certain rate but experiment shows that the actual rate differs from that calculated by a significant amount. What is the attitude of the exact scientist to this result? Does he claim to have explained the phenomenon on the ground that he can put forward various plausible suggestions as to the factors which ought to be considered? Of course he does not. He admits candidly that the phenomenon cannot yet be explained.

The **ad hoc** scientist, on the other hand, claims to have explained a phenomenon if he can show, even in the vaguest way, how it might be connected with other factors. In sociology, biology, and most forms of psychology, there is no pretense whatever at numerical agreement; it is enough to point to certain antecedents and it is not even considered necessary to say why these supposed causes should have produced what, in fact, they did produce and not something totally different. The existence of man, for instance, is explained on an evolutionary basis but no one asks why man as we know him and not some totally different creature was formed: far less is an attempt made to show that an evolutionary process would necessarily produce men of a particular size. Biological “explanation” is clearly what the physicist

would describe as a lack of explanation. The word **explain** is used in different senses in the exact and inexact sciences.

Again, this is not of course said in criticism. Biological problems are so complex that little better could be achieved in any case. The mistake that has been made is one of **attitude**. The **ad hoc** scientist sometimes lacks a sense of humility: he takes over the words of the exact sciences and forgets their original meaning. He fails to notice that even the best explained fact of biology must, from a physicist's point of view, be regarded as unexplained.

The different language employed by the two kinds of science is confusing to the layman. In some instances the old language of the exact sciences seems to have been taken over quite deliberately to create such confusion—rationalist writers at all events frequently trade on the confusion. All arguments to the effect that science can explain, say, religious experience or some historic miracle, are at root dishonest attempts to make the public believe that the word "explain" here has the very definite meaning that it possesses in the exact sciences, whereas those who make these claims should know very well that this is not the case.

Of course if, by **explain**, we only mean that we can suggest antecedent partial causes, no dishonesty is involved. In this limited sense we commonly "explain" the acts of a criminal by pointing out that he did not have a fair chance in life owing to his bad home conditions. Again, we "explain" the conversion of St. Paul by saying that, after watching the heroic death of Stephen, his unconscious mind must have been hard at work and that a sudden realization that he was "kicking against the pricks" was not unlikely to occur in the case of so intelligent a man. All "explanations" of this kind are legitimate in their way, provided we realize fully what we mean by "explanation". If our ideas on this point are clear we shall not be tempted to argue that other causes must be excluded—we shall not be so self-satisfied as to suppose for one moment that our tentative suggestions imply that the criminal was not responsible for his acts or that God did not reveal Himself to St. Paul at an opportune moment.

The degree to which people can become satisfied with a fragmentary explanation is often quite surprising. It is worth while pointing out that even in physics no one would think of arguing in so careless a manner. If we discover that the period of oscillation of a drop depends on the radius of the drop raised to the power of one and a half, we do not dream of supposing that the radius "explains" the period or that other factors, such as the physical properties of the liquid out of which the drop was made, are not involved. Thus scientific explanations often cannot be treated as comprehensive even when exact numerical agreement with prediction is obtained. We should naturally be all the more on our guard against a claim to understand every factor involved when we are dealing with inexact sciences and **ad hoc** concepts.

Another point, all too little realized, is that by employing scientific concepts at all, we are selecting material for which scientific explanation is possible. To use a well-worn analogy due to Eddington, we do not expect a fisherman with a net of a very large mesh to argue that there are no small fishes in the sea because he never catches any. No more can we discover truths about a spiritual world if our methods of investigation precludes them from the start. And this is precisely what the modern **ad hoc** method is delib-

erately designed to do. Lloyd Morgan is honest enough when he says: "From a strictly emergent point of view any notion of a so-called 'alien influx into nature' is barred".¹⁷

However, provided all these points are kept in mind, there is no reason why certain types of **ad hoc** science should not be welcomed by the Christian. Nor can we set any bounds upon such science which may freely invade the field of theology and revelation if a clearer understanding is thereby attained. When God has seen fit to reveal His truths to men, we may be sure He has not done so arbitrarily—often, as in the conversion of St. Paul, the way is prepared by antecedent factors which it is the business of science to discover. It is not science itself but the fantastic and ill-thought out claims that are often made in its name that merit opposition from all reasonable men.

VII

Something may now be said about the doctrine of **positivism**. According to the positivist, modern physics has shown us that it is not possible to reach the "absolute truth" about what lies at the back of nature. We should not, therefore, waste time in attempting the impossible: we should confine ourselves to discovering relations between things which we can actually observe.

This argument rests on a failure to distinguish between measurable and purely qualitative truths. No statement of the value of an incommensurable number, such as pi, is absolutely true, but it is absolutely true that the ratio of the circumference to the diameter of a circle is constant in a two dimensional world. Similarly, statements about function and form may often be absolutely true—a correct statement of the function of a kidney or the structure of glucose will remain true for all time. It is only when we seek the answers to purely numerical questions, such as, for example, "what is the velocity of the earth through the ether?" that we find that we cannot reach answers which are true for all observers.

Again, as Max Planck and Bavinck have pointed out,¹⁸ the positivism of Ernst Mach and his followers only ended in scientific stagnation. The chemist Ostwald, even so late as 1904,¹⁹ was arguing that since atoms were not observable, science must do without them. With great ingenuity he tried to show how Dalton's classical proofs of the atomic theory could be understood in terms of the facts of observation alone. But the existence of atoms was soon confirmed without a possibility of doubt. The amazing faith of the organic chemist who had not hesitated to draw plans of thousands of complicated organic molecules constructed out of unobservable atoms, proved to have been more than justified. Since that time every science can add scores of instances in which unobservable postulates were later found to have a physical reality.

Attempts have sometimes been made to separate observables into two classes, those **theoretically** unobservable (e.g., motion through the ether) and those **practically** unobservable (e.g., the back of the moon or the inside of the earth). It is claimed that physics is only concerned with the elimination of the first kind. A detailed discussion of this subject would be out of place here but it would seem to the writer that such a distinction assumes that we possess an infallible way of distinguishing between the two kinds of unobservables. We must not forget that until the beginning of the present century it was supposed that atoms and molecules, being far smaller than the wave length of light, were theoretically unobservable. Again, in our

own day, the violent controversy which has been aroused by Milne's cosmological theories has largely centered round differences of opinion as to how various classes of unobservables should be classified.

The frantic attempts²⁰ which have been made by a few writers to restate the Machian heresy that science is only concerned with observable entities, nearly always breaks down when it is asked whether a star exists before it has been seen through a telescope. Interminable discussion as to the meaning of the word "exist" in such a case is profitless: the fact is that positivism is not a tenable attitude and even the philosophers and the very few scientists who sponsor it rarely or never apply it consistently. Few of them would, for instance, be prepared to consider a criticism of history or of evolution on positivist lines.

Thus, although we may willingly admit that positivism has a certain value when we are dealing with the purely numerical problems of physics, it would seem that there is little reason for extending the principle. Science, like religion, must often use the eye of faith and seek to peer into realms which lie beyond anything about which our senses can give us direct information.

One further remark on the subject of positivism may be made before leaving. Positivists may be of two kinds. Probably most of them would claim that all discussion of what lies beyond our senses is profitless. This is the variety of positivism which we have been discussing up to the present point. But sometimes we find positivists (Professor Dingle is an example) who claim only that science should not discuss an unobservable world but allow that religion has a right to do so.

As the grounds for believing in positivism are, in any case, so slender, this point of view hardly merits detailed discussion here. But it is of interest because this second type of positivism involves the view that science and revelation are confined to different realms. According to this view, therefore, science and religion must be kept in idea tight compartments of the mind and cannot impinge upon one another.

VIII

We must now turn to consider the sphere of revelation and its limitations, if any, with respect to science.

When, at the beginning of the scientific era, science first began to meet with conspicuous success in its attempts to explain the workings of nature, organized Christianity reacted towards it with a tragic lack of wisdom. At times attempts were made, by persecution and threatening, to restore the *status quo*. When that failed the church gave way on point after point.

A case²¹ can be made out for supposing that the church systematically fought every new scientific idea which impinged, even in a remote way, upon theology or the Bible, until her opposition became so ridiculous that it had to be abandoned. It has, however, been shown²² that this interpretation is unfair. At any given epoch, radically new scientific ideas were always opposed to the prevailing science of the time and it was only natural that the church, in common with all other non-specialists in scientific matters, should have accepted the best available evidence of the time. Even in the case of the evolution controversy, perhaps the most bitter and tragic controversy that ever took place between science and religion, the battle was at first confined to powerful personalities in the scientific field and in no way involved religion.²³

Whatever the historical truth on such matters may have been, the impression was created among the masses and deliberately fostered by rationalist propa-

ganda, that the church was fighting a losing battle. The fantastic definition of a miracle as "an event that cannot be explained by science"²⁴ was exploited to the full. The rationalist press presented the public with the spectacle of science cheerfully explaining every new problem with which she was confronted, so that the number of events which could properly be called miraculous became fewer and fewer. Obviously science was conquering all along the line. Religion—once the proud possessor of all knowledge—was now, we were told, being forced to take refuge in one very small compartment of human experience—the part that deals with mysticism and religious intuition. And the science of psychology was already invading this sacred sanctuary. No reasonable person ought to doubt that it would ultimately be as successful here as it had been everywhere else.

Such is the picture drawn by the self-satisfied rationalist. We have already examined its falsity from the scientific side. We have now to examine the matter from the religious angle.

It is clear that religion has involved itself in difficulties through its attempt to find a rigid definition of miracle. To a discussion of this question we shall therefore now turn.

At this point a consideration of the idea of causation in the Bible is of great importance. Throughout the Scriptures we continually observe that no systematic attempt is made to distinguish between the direct and the indirect working of God. Let us take a few examples, almost at random, from the Book of Psalms. God is the cause of storms (xxix); all nature is full of His loving kindness (xxxiii, 5); He created the heavens (xxxiii, 6) and now fashions the hearts of all men (xxxiii, 15); He sends calamities (lx, 2), rain and harvests (lxv, 9) and performs wonders for the sake of His people (lxvi, 6, lxxvii, 14, lxxviii, etc.); He provides food for the young lions when they roar after their prey (civ, 21); He has beset us behind and before and laid His hand upon us (cxxxix, 5).

In the New Testament we encounter precisely the same outlook. We are frequently reminded that God showed His power through the miracles of our Lord and that He finally raised Him from the dead. Nevertheless, according to the teaching of our Lord in the Sermon on the Mount, it is God who sends day and night, who clothes the lilies of the field and who sends His gifts of rain and sunshine upon the evil as well as upon the good.

From a study of these and similar passages the conclusion has been reached²⁵ that neither the ancient Hebrews, nor the Hebrew Christians of a later day, were familiar with our sharp distinction between the natural and the supernatural. This view certainly cannot be correct, for if this were really the case it is difficult to see why **particular** works of God—the plagues of Egypt or the resurrection of our Lord—should have been regarded as more significant than, shall we say, the clothing of the grass of the field. It is certainly clear that from time immemorial a distinction has been drawn, at least occasionally, between the natural and the supernatural. Even the Egyptian magicians (Ex. viii, 19) were prepared to say, "This is the Finger of God" about certain events but not about others.

Nevertheless, the passages that have been cited certainly show that in the Hebrew-Christian tradition nothing like the stress was placed upon the distinction between the natural and the supernatural that came to be placed upon it in later times. The Bible says

fearlessly that all events which are for the good of man and beast are done by God. As a rule it does not attempt to distinguish clearly as to whether these events are performed by God in a direct or an indirect manner. Our Lord knew well enough that each day and night was not **separately** planned ahead by His Father: what He stresses is the fact that the general ordering of nature is the work of God.

Thus we see that, for the early Christians, as also for the Jews, God was seen to be at work throughout the whole of nature, sometimes directly but more often indirectly—for nature itself was His handiwork. In some cases (as in the resurrection of our Lord or the giving of the spirit at Pentecost) God's work was so immediate and so obvious that no one could reasonably doubt that direct interventions had taken place. But at other times—who could tell whether events were really miraculous? And, in any case, what did it matter? Enough that God had made the laws of the universe so that everything that happened for the good of His creation was a revelation of His character.

The rigid distinction between the natural and the supernatural is a product of later times—a natural development of the Biblical teaching to be sure, but not there from the beginning. The problem must soon have come to the fore in early Christian ages in connection with the miracles of the saints—for the church came to regard miracles as a prerequisite for canonization and it naturally became important to know whether unusual events in the lives of the saints were genuinely miraculous.

But as in other familiar instances, doctrinal development created serious difficulties. After centuries of argument, when the distinctions had been made with infinite subtlety and apparent finality, the development of science created a bewildering mass of new problems. The old astronomy, with its angels pushing the stars through the sky, collapsed like a house of cards. In time even the odour of sanctity—the miraculous sweet smell which exuded from the bodies of many of the mediaeval saints shortly before they entered Paradise—turned out to be nothing other than the production of acetoacetic acid and acetone caused by faulty metabolism in the diabetic. Even the bleeding host, that most awful of miracles in which the transformed element of the sacramental bread revealed the sufferings of our Lord, turned out to be nothing more startling than the invasion of a bacillus. These and many similar instances showed how tragically the church had failed to draw the correct distinctions. No wonder that the growth of science seemed to place the Christian faith in a ridiculous light and to furnish the religious antagonist with the most effective weapon he had ever possessed.

The claims of rationalistic science against religion are thus seen to have been the result of an attempt on the part of the church to be wise above that which was written. Had Christians resolutely refused to pretend that they knew enough about nature to be able to distinguish between the natural and the supernatural, difficulties would never have been encountered. The Christian would have thanked God for every manifestation of His goodness: he would have spoken naturally of God who made the lilies of the field, the stars, the lightnings, the rivers, the mountains, the sunsets, the mineral veins and the works of good men. But he would never have pretended to know whether these works of God had come directly from His hand, or whether they might not have been innumerable stages between God the First Cause and the effects which give joy

and gladness to the hearts of men. As a result he would have welcomed every reverent attempt to understand the means God has employed to produce the wonderful things that we see around us, and all arguments of the type "Natural law can explain this or that, so God is an unnecessary hypothesis" would have seemed stupidly irrelevant.

Thus, if the Christian Church could have been saved from the purely verbal wisdom of the middle ages with its almost unlimited intellectual conceit inherited from the ancients no warfare between science and religion would have come about. Even the suggestion of the possibility of such a warfare would have appeared fantastically impossible. How irrelevant it might have been may be illustrated by means of a simple analogy. Suppose a girl receives a present through the post from her lover, what would she think of a sceptically minded person who told her that since she had only received the present from the postman she should cease to attribute it to the original sender? Would she not at once reply "What does it matter whether he gave it to me himself or whether he used collectors, sorting officers, the railways and finally the postman to send it to me? His motives are the same in either case." In the same way science studies the means whereby God fulfils His purposes and no amount of study of the means can ever explain away the purposes themselves.

The Christian must insist, therefore, upon his right to interpret nature in the light of the revelation of God given by Jesus Christ. He must be completely free, even as Jesus was, to see the workings of God in any direction in which the teleological evidence indicates that He has been at work. There must be no question whatever of invoking God as an explanatory principle only when science fails to produce an explanation: the Christian outlook can recognize no limitations in relation to science. Only when our minds are free to see the workings of God in any and every direction in which He may have been at work, shall our hearts overflow with thankfulness for the beauty of the world in which He has placed us for His glory.

This is the true Christian attitude towards the matter we have been discussing. When once it has been wholeheartedly adopted, it creates its own safeguard against narrowness and prejudice. For the Christian will realize that science also has an unlimited right to pursue her investigations of the immediate causes of things and he will rejoice in every fresh discovery she makes—unless it is a discovery for evil. The Christian who returns to the early Hebrew-Christian tradition of thought will never forget, moreover, that when, in Holy Writ, we are told that certain things were done by God we are not told whether God saw fit to use natural means for accomplishing His purposes. So if it should turn out that some of the things which are generally thought to involve God's immediate creative power could, in fact, have come about by natural means, he will accept the discovery joyfully. In some cases this has already occurred—there is no reason to think that God performed a **special** miracle when He set His bow in the cloud as a token of His covenant that He would not again destroy the earth with water. But the Christian—and let us hope not the Christian alone—will rightly complain if, on the one hand scientific explanations are misused to eliminate God from His creation or if, on the other hand they turn out to be mere verbal subtleties which are neither scientific nor explanatory.

In addition to the danger of misusing religion in

order to oppose science, there is also another danger. In science we sometimes find that a principle, sound as far as it goes, is misapplied to realms of knowledge for which it was never intended with results that are often harmful and ludicrous. Those who would see the workings of God in nature are faced with an exactly parallel danger. Clearly we must not feel it incumbent upon ourselves to suppose that **everything** in nature is to be explained in terms of the plans of God. Indeed, this will clearly not be the case. In achieving one plan, a score of unintended results may also follow of necessity. If we suppose, for example, that God deliberately made the world beautiful, then the beauty perhaps, of sub-microscopic forms of life, which is unlikely to make man happy, may also have followed from necessity. Clearly every point must be considered on its own merits and we must be careful never to force facts into grooves into which they do not naturally fit. As an example of the type of detailed explanation of Providence of which we must ever beware, we may cite the mediaeval theory that God made the bed-bugs to wake us up in the morning and thus to save us from laziness!

While we must always be humble in our supposed understanding of the **details** of Providence this does not mean that the religious interpretation can itself be thrown overboard on account of a few facts which do not fit readily within the general scheme. When we find that science fails to explain a phenomenon we do not abandon science. No more should we abandon our Lord's interpretation because, on rare occasions, we do not understand how it can be applied to a particular problem. Rather must we continue to look for light and remember that the mass of evidence in support of a Divine plan in nature cannot be set aside because we are too dull-witted to see our way through certain difficulties.

Finally, just as the scientific approach fills our minds with humility when we contemplate how little we know, so the religious approach will produce the same effect. God's ways are greater than our ways and His thoughts than our thoughts, nor can we ever hope to do more than scratch the surface of the vast oceans of unknown truth that lie around us.

Discussion

The Chairman said: Dr. Clark has performed a very useful service in defining the methods and the scope of science. Much of the conflict between science and religion has arisen from confusion on the subject of what is science and what is religion. It is therefore of the utmost importance that we should have a clearer idea of their respective provinces. In former days it was the church that stepped out of its province and dictated to men what they should believe about the physical world around them. In these days it is often the scientists who repeat this error. The mistake is made not so much by the great scientists as by those of lesser calibre. Because science now speaks with great authority many people are misled by these irresponsible statements. Science has such great achievements to her credit that uncritical people have implicit faith in her pronouncements. It is therefore of the utmost importance that everybody should have a clearer idea of the **modus operandi** and the limitations of the scientist. Some people have made the definition of science so wide that they consider it to be tantamount to organized knowledge. If this were true, then, everything would come within the scope of the scientist, including what was once called the Queen of the Sciences, theology. As Dr. Clark has said: "It is not science it-

self but the fantastic and ill-thought out claims that are often made in its name that merit opposition from all reasonable men."

I regard it as being the function of a Chairman to encourage discussion and I now leave it to others to speak on this important subject, "The Spheres of Revelation and Science". I am glad to see that there are many young people present and I would particularly invite them to give us their views.

Mr. Charles H. Welch said: In the paper submitted by Dr. Clark is the statement: "If all the facts were known, no disagreement between science and religion would ultimately remain."

It should be held before the mind constantly that "Truth" is "Relationship", and when all relationships are known, all truth will be known also. If I say "No. 12, Queen Anne's Gate" I make a statement, but I can scarcely say that I have uttered a "truth". Such a statement cannot be approved or refuted, it neither affirms nor denies, and it is impossible to act upon it. If, however, I say "No. 12, Queen Anne's Gate is the address of the Victoria Institute," I utter a "truth," because I have discovered and affirmed a relationship.

The paper submitted by Dr. Clark while insisting on the separate spheres of Revelation and Science, very wisely urges all, whether Scientists or Theologians, to remember that their discoveries, until related, will not lead them to the goal unto which each in his separate way hopes to attain.

WRITTEN COMMUNICATION

Mr. W. F. Spanner, wrote: When Dr. Clark states that the "church" has always stood for a policy of secrecy, I presume he means the Roman Catholic church. His statement is not wholly true of the Protestant Reformed churches which have insisted generally on freedom for learned men to investigate the truth, and have also been prepared to tolerate unlearned speculations by men who desired to air their own opinions. Such investigations hold out the possibility of enlarging the church's understanding of the sacred scriptures; but whilst this is true the churches loyal to the Reformed tradition have never allowed the special revelation given in the Holy Scriptures to be wrenched from their grasp. Care has also to be taken in exercising discrimination between what is genuine learning based on concrete evidence and what is merely fanciful speculation. I think the value of this paper would have been increased had Dr. Clark distinguished between the attitude of different branches of the church (i.e., Roman Catholic, Lutheran, Reformed, and Anabaptist) to the question of freedom for science and speculation. Perhaps he will deal with this point in his reply.

It seems to me that whilst this paper has many excellences and Dr. Clark has placed us under a debt it does not quite succeed in giving a clear view of what it sets out to do, namely, define the limits between revelation and science. I think more attention is required to defining our terms. I take it that science is simply "classified knowledge," or "systematized knowledge"; and it has to be carefully distinguished from what is merely speculation. I think that theology is still rightly to be regarded as the "Queen of the Sciences" because it deals with the systematization of the highest knowledge of which man is capable, namely, the knowledge of God. Such theology falls naturally into two departments; natural theology which deals with the general revelation God has given to us through the ordinary course of nature, and special

theology which deals with the special revelation of Himself which God has given in the Holy Scriptures, which revelation was added because of sin. Again, true theology must be distinguished from mere philosophical speculation dressed up as theology.

Revelation, I take it, is God's revealing of Himself to mankind and consists of general revelation given through the ordinary course of nature, and special revelation given through the medium of the Holy Scriptures. The voice of conscience and the sense of the beauties and the joys of life (What man is there anywhere who does not count life to be valuable? This being so all men are under a self-confessed obligation to give thanks to God) are part of general revelation and if man were untainted by sin would be sufficient to give a complete knowledge of God as his Lord and Creator. The Holy Scriptures were necessarily added because of sin and to reveal God as Redeemer.

Agnostic scientists may benefit us greatly insofar as their efforts are genuinely devoted to an appraisal of the true facts of nature, but we may be seriously led astray if we do not take care to separate the facts from the fancies. We live in days when there is a strong tendency to endeavour to force facts to fit into preconceived fanciful theories in the interests of the prevailing Modernist philosophy which has as its root principle the glorification of man in place of the glory of God.

I have poorly expressed what I wanted to say, but trust it may assist towards a better harmonizing of modern knowledge with faith.

To sum up on the basis of the foregoing remarks, I suggest that true science (carefully checked by close attention to the facts, and sifted from fanciful speculation) is best considered as the intellectual aspect of revelation. All of us according to the measure of the understanding which God has given unto us may behold something of the glory of God in the intellectual mirror called science.

FOOTNOTES

1. *The Mission of Science*. Presidential Address to the Royal Society, Nov. 30, 1945.
2. See E. T. Whittaker, *History of the Theories of Aether and Electricity*, 1910
3. H. Dingle, *Science and Religion* (Union of Modern Free Churchmen), 1945
4. Compare the scathing and amusing denunciation of much *ad hoc* scientific thought in E. B. Holt's *Animal Drive and the Learning Process*, 1931
5. The physical examples Lloyd Morgan cited in order to illustrate these assertions were generally unfortunate. Thus, he was of the opinion (Gifford Lectures, *Emergent Evolution*,

1923, p. 66, etc.) that no amount of study of single atoms would enable us to predict the way in which they would group together to form a crystal or liquid at a lower temperature. The very thing which Lloyd Morgan deemed to be impossible has since been accomplished. A study of the deviations of gaseous argon from the classical gas laws has enabled the exact positions of the atoms in the crystal lattice to be predicted successfully.

6. See F. Engels *Dialectics of Nature*, 1940, etc.
7. O. Stapledon, *Essay in Freedom of Expression*. Ed. H. Ould, 1945, p. 16. See also *In Search of Faith*, Ed. E. W. Martin, 1943, etc.
8. See for example, H. Levy, *The Universe of Science*, 1932. Also H. Dingle, *Through Science to Philosophy*, 1937 and *The Laws of Nature*, (*Nature*, 1944, 153, 731, 758)
9. C. H. Waddington, *Science and Ethics*, 1942
10. For example by W. W. Carington, *The Meaning of Survival*, Myers Lecture, 1935. Also by behaviourist psychologists in general.
11. O. Stapledon in *Freedom of Expression*, *Vide supra*
12. *Aspects of Dialectical Materialism*, Watts, 1934, p. 92. Bernal is careful to explain that his criticism applies to many forms of science as well as to theology.
13. For a methodological type of positivism in which this is not the case, see later, p. 157
14. A. O'Rahilly, *Electromagnetics. A Discussion of Fundamentals*, 1937
15. J. Mackaye, *The Physical Cause Back of the Relativity Equations*, *Journal of the Franklin Institute*, 1934, 218, 343. In this connection the interesting criticism of relativity by A. Eagle (*Trans. Victoria Inst.*, 1938, 70, 177) should be noted.
16. See R. O. Kapp, *Science versus Materialism*, 1940, p. 202 ff. for an able discussion of the meaning of causation and explanation in scientific thought.
17. *Emergent Evolution*, p. 13
18. See B. Bavink, *The Anatomy of Modern Science*, 1932, p. 31 ff.
19. *Journal of the Chemical Society*, 85, 506.
20. Professor Dingle, in his *Through Science to Philosophy*, never really faces this issue. Dr. Philipp Frank, who still bravely adheres to the positivist faith in his book *Between Physics and Philosophy* (1941), writes as if encumbered by unanswerable perplexities and frankly admits that very few, if any, scientific workers in the world, outside the original Vienna circle, agree with him.
21. A. D. White, *History of the Warfare of Science with Theology*, 1896, etc.
22. J. Y. Simpson, *Landmarks in the Struggle between Science and Religion*, 1925.
23. C. E. Raven, *Science, Religion and the Future*, 1943, R.E. D. Clark, *Darwin: Before and After*, 1948.
24. Unfortunately this definition has often been seriously put forward by Christians. Thus C. A. Row, in a well-known popular work of Christian apologetic, defines a miracle as "an event for the occurrence of which no forces, or combination of forces, is able to account", (*A Manual of Christian Evidences*, 10th ed., 1899, p. 8). Examples of such indiscretions could easily be multiplied.
25. John MacMurray, *The Clue to History*, 1938.

BIOLOGY

by

Irving W. Knobloch

Since the membership of the Affiliation encompasses many fields, this new column may contain items of interest to those who are not professional biologists. Naturally those in the field of biology will seldom if ever be startled by the writer's disclosures.

Spontaneous Generation

Some surprise may be caused by the title of our first offering because the view is held by most people that abiogenesis is non-controversial having been done to death by Louis Pasteur and John Tyndall. To say flatly, however, that organisms never arise *de novo* is a universal negative and can never really be proven. Abiogenesis is therefore not a dead issue, in fact, it was revived a short time ago when the bio-chemical nature of the viruses was being studied for the first time.

It might prove instructive to review some of the history of this question.

Although Aristotle had some fairly modern ideas about reproduction, he still believed that "some plants—are of spontaneous growth—some animals are produced from animals of similar form, the origin of others is spontaneous—." Lucretius followed in the same vein "And many living creatures even now spring out of the earth taking form by rains and the heat of the sun". Virgil gives his formula for generating bees from the fermenting moisture "growing warm in the softened bones".

In Judges 14: verses 5 to 8, one will find the account of Samson killing a lion and "after a time—he turned aside to see the carcass of the lion: and, behold, there was a swarm of bees and honey in the carcass of the lion". This might be interpreted by some to mean that Samson thought that the bees were spontaneously generated in the lion. The quotation does not say this, however, and, in my opinion, the Bible cannot be accused of being "unscientific" in this case.

All of these incidents occurred in the dim past. In 1652, however, Van Helmont, a renowned physician and plant physiologist, insisted that rats came from a pot of wheat and a dirty shirt (note that shirt must be dirty) after about twenty-one days. Alexander Ross had worms originating in cheese and timber, beetles and wasps in cow dung and mice from the mud of the Nile.

The only discernible ray of hope comes from a statement in Homer's Iliad where we note that Achilles was afraid lest flies enter the wounds of the dead Patroclus and breed worms therein. Whether this observation was original or not, we cannot say, but it formed a spur which led to the overthrow of many ancient ideas on the origin of living forms.

This statement by Homer was read by Francisco Redi and it started a train of thought in his mind which had great consequences. Redi set about devising what has been described as the first controlled experiment, an event from which our modern scientific methods have developed. Redi made a hypothesis as follows—"and although it be a matter of daily observation that infinite numbers of worms are produced in dead bodies and decayed plants, I feel, I say, inclined to believe that these worms are all generated by insemination and

that the putrified matter in which they are found has no other office than that of serving as a place, or suitable nest, where animals deposit their eggs at the breeding season—I assert that nothing is ever generated therein."

Having written this, he made a series of experiments to gather some data. He had two sets of jars of meat, one he covered with gauze and the other he left open. In the covered jar, maggots never developed and he reasoned correctly, that flies had not been able to enter and lay their eggs in the meat. One set of jars served a control for the other set and the only variable factor was the material covering the jar.

There are two other aspects to Redi's work which are not usually stressed. One is that the meat spoiled in the covered jars as well as in the uncovered ones. Redi apparently thought little of this since bacteria were not discovered until about eight years later by Leeuwenhoek (1676). In fact wonderment as to the origin of the bacteria did not become noticeable for several decades.

The second point which needs emphasizing is that one may be quite ingenious and intelligent about some things and yet have mental blocks about others. Redi disproved the spontaneous generation of worms in meat but, strangely enough, he still held that gall flies were spontaneously generated.

When the intelligentsia conceded the natural origin of the visible forms of life, they turned their attention to the origin of the unseen organisms. Here we can learn another lesson about science activities: the entire field of bacteriology marked time until the microscope was invented and improved. This same principle holds true in other fields. Scientific advance continually demands more and better tools.

In the eighteenth century the controversy about spontaneous generation became heated, to say the least, with an English priest, Needham, and an Italian priest, Spallanzani, furnishing most of the fire. To avoid boring my readers, we will briefly state that Needham was unable to prevent the growth of micro-organisms (thus proving their spontaneous generation, in his mind) mainly because of faulty techniques. Spallanzani showed that proper heating and proper stoppering of flasks would preserve them indefinitely. He also confounded Needham by proving that the "vegetative force" in the flasks was not destroyed by the long boiling. Sterile, boiled flasks could and did develop growth if they were exposed to the air!

In the concluding portion of this history, we shall recount the battle of wits between Pouchet and Pasteur which highlighted the scientific portion of the nineteenth century.

(To Be Concluded)

SOCIOLOGY

by

Frank E. Houser

Two articles having relevance to Christianity appeared recently in sociological journals. The frequency with which such articles appear indicates that religion as a research topic is a peripheral matter for most sociologists. This is in spite of the rich heritage of social theory given by such men as Troeltsch, Durkheim, and Max Weber. Interestingly enough, there is a

veritable plethora of material germane to Christianity coming forth in other media than the journals. But this outpouring is not research. It is philosophizing. As such it is extremely pertinent, and it will be discussed in this column in the future. However, until it issues forth in solid social theory with hypotheses ready for and subjected to testing it will not be taken seriously by sociologists of empirical persuasion.

There is this to be said in regards to an empirical approach. In religious circles it is not hard to find discussions long on logic but deficient in data. The happy marriage of theory and fact is all too rare. Among the shining exceptions to this tendency are the aforementioned articles. The first is found in Dr. David Moberg's work on the relationship of Christian belief to personal adjustment in old age. This Bethel College professor recently published a summary of research in the February 1953 *American Sociological Review*.

Here are several of the findings: "This study of institutionalized aged people has indicated for the sample of persons studied (1) that the relationship of church affiliation to good personal adjustment in old age is spurious; it is probably due to the religious activities and beliefs associated with church membership;" . . . "(3) that former church leaders are better adjusted in old age than church members who did not hold positions of leadership;" . . . "and (5) that holding orthodox Christian beliefs is related to good personal adjustment in old age."¹

Dr. Moberg is careful to avoid the interpretation that a causal relationship has been established. While we may prefer to believe that the Christian religion is good medicine for soul, mind, and body the limitations of even a high correlation demand that we posit an alternative interpretation, viz.: those aged folks having high scores on attitude inventories of personal adjustment may be just the ones who normally turn to orthodox religion.

At any rate here are data which may help in the general problem of the relation of religion to personality. Some claim it is "normal" for the Christian to tend to neuroticism. At least in the aged group Moberg studied—and assuming the attitude inventory valid—this is not the case.

Before leaving the Moberg research it ought to be pointed out that the methodology of the study is very clean. Using experimental and control groups in which all factors were kept constant except the one of interest gives a rigor to the work that is striking. Control variables included sex, education, marital status, family status, club membership and participation, self-rating of health, present employment, and age. Similar studies of different age groups in varying social circumstances would contribute materially to the general clarification of the relation between religion and personality.

The second journal article relevant to Christianity is by Isidor Thorner, and appears in the *American Journal of Sociology*, Vol. LVIII, July, 1952 under the title "Ascetic Protestantism and the Development of Science and Technology". In contrast to the Moberg work which deals with the relation of religion to the personality, the Thorner work is concerned with the relation of religion to society.²

Digging in the rich vein of thought first opened by Max Weber in his *The Protestant Ethic and the Spirit of Capitalism* (and later expressed in his *General Economic History*), Thorner takes issue with certain critics of Weber. Weber had contended that the development

of science and technology was due in large part to ascetic Protestantism. Weber's critics, including Pitirim Sorokin, claimed that the development was not a feature of Protestant countries—at least prior to the 18th century—but of Catholic countries like Italy.

What is at stake here is not the historical fact of which religious group contributed more to the development of science—although this enters into the argument—but, rather, whether an hypothesis in sociology shall be sustained.

The hypothesis concerns the determinative nature of certain group attributes. In this case the group attributes are the beliefs of ascetic Protestantism. One of the main beliefs involved disciplining oneself to postpone immediate gratification. Thus Protestantism encouraged a capacity to suspend judgement, the development of an affective neutrality. And, this trait was of prime importance in scientific work. Hence the proposition that certain traits of ascetic Protestantism were largely responsible for the development of science and technology.

The Catholics of the time had no similar emphasis on self-discipline. Furthermore, the individualism of Protestantism encouraged a rationality with the authoritarianism of the Catholic hierarchy could not abide.

It is Thorner's burden to sustain the plausibility of the hypothesis. To do so he offers historical evidences which Weber's critics have not considered. First, Prof. Thorner gives the number of discoveries and inventions per one million population in the major European countries at certain times in the 17th, 18th, and 19th centuries. Such use of proportionate figures places in proper perspective large and small countries. For example, Denmark, Sweden, Norway, and Finland with a population of 2,000 and 1,600 had a rate of 3.00 discoveries and inventions per one million population. On the other hand, Italy in the same year had a population of 13,000, contributed 37 inventions or discoveries, at a rate of 2.85. A survey of the data indicates that Protestant populations have always had higher rates with the exception of France. And, to show France no exception to the rule, Thorner offers historical evidence which indicates that a goodly proportion of scientists in France were Protestant.

Obviously, Thorner's conclusions depend on the validity of historical observation. In any case it is a good example of modern sociology's attempt to get at significant propositions by employing historical data. Unfortunately, in attempting to give significant contributions as broad as society it is necessary to sacrifice precision.

This proposition may be of special interest to members of the ASA. To demonstrate its modernity would be a difficult task. The Weltanschauung of Western man has changed so drastically since Luther's and Calvin's time that it is a commonplace to associate scientists with unbelief. As a matter of fact it is now considered important enough to write a book indicating that some scientists do have a religious belief!³

FOOTNOTES

1. David O. Moberg, "The Christian Religion and Personal Adjustment in Old Age", *American Sociological Review*, Vol. 18 (Feb. 1953), p. 87.

2. No dichotomy of personality and society is implied here. While these are inseparable, to abstract for the purpose of understanding is permissible.

3. Edward L. Long, Jr., *Religious Beliefs of American Scientists*, The Westminster Press, 1952.

PHILOSOPHY

by

Robert D. Knudsen

Philosophical Miscellanea

With this issue we are beginning a new section, in which we shall report on important developments and publications in the field of philosophy. We are interested especially in noting material that will be of help to those who are working as Christians in the special sciences. We wish to direct them to literature and ideas that will aid them in analyzing the theoretical foundations of their respective fields. This column will not be devoted mainly to philosophy in general but to the philosophy of physics, jurisprudence, sociology, etc. To this end reports will be made on vital books, pamphlets, and articles, accompanied by brief comments. From time to time specialists in their fields will be requested to comment on important events and publications. Both old and new material will be reported, but the aim will be to concentrate on the latest significant movements. Special attention will be given to the work of Christian thinkers, whenever something of sufficient merit appears. There will also be reports on interesting foreign publications as these come to our attention. There is much vital work being done in philosophy and science by Christians abroad.

This is a new column. It is in the experimental stage. It will therefore be very flexible, and any suggestions from the readers would be appreciated, as to how the column should be written and as to books and articles that should be mentioned. The editor in charge of this section would be pleased to receive any material the reader would like to send in for consideration, though there can be no guarantee that such material will be mentioned. This column will appear regularly every three months, and it is hoped that it will be of aid in acquainting the reader with important material that may have escaped his attention.

As a beginning we wish to point out some significant material that has appeared in the Netherlands from the pens of Christian thinkers. America is becoming more and more acquainted with the work of Dr. Herman Dooyeweerd, professor of law at the Free University of Amsterdam. Dooyeweerd is a strong thinker who has followed and expanded the thought of Abraham Kuyper, especially with reference to his own field of jurisprudence. A deep study of his field led him to seek its theoretical foundation. This study resulted in the publication of a large, three-volume work, *De Wijsbegeerte der wetsidee* (*The Philosophy of the Idea of Law*). Amsterdam: H. J. Paris, 1935. Here he sought the theoretical foundations of law in a specifically Christian cosmology and epistemology. Those unable to cope with the Dutch will be interested to read the English translation of this work, of which the first volume is now in preparation. Until this volume appears we have access to an historical sketch of the development of this philosophy in the work of Dr. Young of Butler University: *Toward a Reformed Philosophy*. Grand Rapids: Piet Hein Publishers, 1952, 155 pp. This volume contains an extensive bibliography of pertinent books.

Dr. Dooyeweerd's field is that of law, though he is also at home in the fields of philosophy and sociology,

and he is making a deep study of classical times. His early reflections on the field of jurisprudence are typified in his inaugural address delivered when he assumed his professorship at the Free University in 1926: *De betekenis der wetsidee voor Rechtswetenschap en Rechtsphilosophie* (*The Meaning of the Idea of Law for the Science and Philosophy of Jurisprudence*). Kampen: Kok, 112 pp. A later work is an analysis of the crisis in the modern idea of the state: *De crisis in de Humanistische Staatsleer in het licht eener calvinistische kosmologie en kennistheorie* (*The Crisis in the Humanistic Idea of the State in the Light of a Calvinistic Cosmology and Epistemology*). Amsterdam: Ten Have, 1931, 209 pp. In a recent work Dooyeweerd again takes up one of the themes of his work of 1931: *De strijd om het soevereiniteitsbegrip in de moderne rechts- en staatsleer* (*The Struggle concerning the Concept of Sovereignty in Modern Jurisprudence and Politics*). Amsterdam: H. J. Paris, 1950, 62 pp. This important study is of interest especially because of the present contest between internationalism and the recognition of national sovereignty. The last work of this author we shall mention appears in the Communications of the Royal Netherlands Academy of Sciences: Division of Letters, new series, vol. XIII, No. 5: *De modale structuur van het juridisch oorzakelijkheidsverband* (*The Modal Structure of Juridical Causality*). Amsterdam: Noordhollandsche Uitgevers Maatschappij, 1950, 49 pp. Here Dooyeweerd treats the well-worn subject of causality, but from the novel viewpoint of his Christian cosmology. The depth and incisiveness of these works invite the study of the Christian scholar, despite the hurdle he must pass because of the language.

As we have said, Dooyeweerd accepts and develops fundamental thoughts in the work of Abraham Kuyper. One of the most influential ideas that Kuyper developed was that of sphere-sovereignty. One meets this idea, e.g., in his work, *Calvinism*. An extension of this principle lies at the basis of Dooyeweerd's ontology and sociology. An extensive discussion of sphere-sovereignty comprises the doctoral thesis of Dr. J. Dengerink: *Critisch-Historisch onderzoek naar de sociologische ontwikkeling van het beginsel der "Souvereiniteit in eigen kring" in de 19e en 20e eeuw* (*A Critical, Historical Investigation of the Sociological Development of the Principle of Sphere-Sovereignty in the 19th and 20 Centuries*). Kampen: Kok, 1948, 285 pp.

In the same spirit as this philosophy there is the extensive doctoral thesis of Dr. Ir H. Van Riessen: *Filosofie en techniek* (*Philosophy and Technology*). Kampen: Kok, 1949, 715 pp. This is a discussion from the pen of a Christian, professor at the institute of technology at Delft, of the important subject of the Christian faith and technical development. The problems of technology and objectification have been pinpointed by recent philosophical and theological work. For instance, in its broad scope the problem of objectification is fundamental in theologians of a Barthian stamp; it assumes great proportions in the philosophy of Nicolas Berdyaev; it is a source of tragedy in the thought of Sartre; and it is the subject of passionate treatment in novels such as the tragic *Le vingt-cinquieme heure*. Wherever existentialist philosophy has made itself felt these problems are central. Dr. Van Riessen's study, covering as it does such a great number of pages, is the most extensive treatment of the problem of technology from the Christian point of view.

The movement we have been discussing is one of

the major schools of contemporary Christian philosophy. As such it is worthy of the attention of Christian scholars in this country. Its writings will shortly become more accessible, since several of them are in process of being translated into English. For an insight into the work of the Free University in general one may consult its periodical in English, **The Free University Quarterly**.

As a beginning, we have dealt with only one line of thought, though an important one. In later issues we shall scan recent publications in scientific and philosophical periodicals in order to help the reader to be aware of current trends of thought.

Rockmont College, Denver

GEOLOGY

by

Karl Turekian

For the Christian interested in relating his Biblical beliefs to modern day scientific knowledge there are evident two main problems. The first problem is correlation of details or individual events in Scriptures with available scientific information. This process has been most successful in the field of archaeology. Though attempts have been made for such relationships in the physical sciences the results have not been universally convincing. One such detail I have seen used in a Christian periodical is the interpretation of Isaiah 40:22 ("He that sitteth on the circle of the earth . . .") as reference to the essential sphericity of our planet. Considering the poetic nature of the whole passage such a correlation is highly questionable.

The second problem is at the same time more basic than the first and also less tangible. Perhaps we could call it the correlation of Biblical **cosmology** with modern **cosmogonies**. The three main questions here are: the origin of the universe, the origin of man, and the phenomenon of the Flood. It is debatable as to which of these has received the most attention in the past few years in Christian circles.

A reflection of the impact of recent scientific work on Biblical interpretation is found in a recent article in the Christian publication **Signs of the Times** ("How old is the earth?" April 17, 1953; Vol. 80 No. 13). The article, dealing with radiocarbon dating and the Flood, was brought to the attention of Mr. Herbert W. Feely, Instructor of Geology at Shelton College, by one of his students. Mr. Feely has himself done work on radiocarbon dating with Prof. J. L. Kulp at Columbia University.

Mr. Robert W. Woods, the writer of the article, has

made some unique suggestions regarding the meaning of the apparent antiquity of certain biological materials examined by the radiocarbon method. He correctly states that Carbon 14 has given a good correlation with historically dated items back as far as 4500 years ago (perhaps longer). It must be remembered that by definition everything existing before man has recorded them with reference to a standard must be considered as pre-history. Man existing before that would have the ominous title "pre-historic man". This would tell nothing of his relationship to God and man; it would only tell that he did not write about it. There is no reason to postulate a sudden break 4500 years ago. Hence it appears feasible to logically extrapolate the dating curve backward in time beyond "history".

Essentially Mr. Woods argues that since there was no rain before the flood, a mist existed above the surface which prevented the Carbon 14 being formed from penetrating into the lower atmosphere to enter the biological cycle. Hence a specimen a year (say) before the deluge would appear very ancient by the extrapolation process.

A further argument he uses is that lifetimes were shorter after the flood—a direct consequence, he states, of the presence of radioactive substances within the biological system. In this last point Mr. Wood fails to consider both the minute quantity of radioactive material within the system or the very slight effect of "soft" beta particles (from the decay of Carbon 14) as compared to the heavy radiation damage of more energetic particles.

Mr. Feely has pointed out several points which are perhaps indictments against arm chair interpreters not having knowledge of the experimental procedures employed. I quote directly from Mr. Feely's letter to the Editor of the **Signs of the Times**:

"(Mr. Woods) . . . quotes ages given by Dr. W. F. Libby for several glacial moraines, for several samples from peat bogs, and for a sample of charcoal from a fire in a cave. Mr. Woods refers to these as "earliest peat bogs," "earliest ice age moraines," and (to the charcoal) as "earliest trace of man". Such statements are unfounded and ridiculous. Dr. Libby neither states that these samples are "earliest," nor says anything that might be thought to imply that they are. Indeed the moraines dated belong to the second youngest of the four recognized Pleistocene ice ages. The peat bogs dated are quite young compared to those which formed the coal beds of West Virginia and Pennsylvania. The cave charcoal is considered much younger than some alleged evidences of man . . . In any event these samples were all taken from surficial materials which represent a thin veneer on a mass miles thick of much more ancient geologic formations. The Carbon 14 method of age determination is very useful in archaeology but hardly scratches the surface of geologic time."