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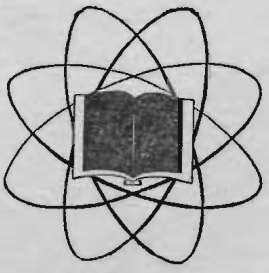

The fear of the Lord is the beginning of wisdom. Psalm 111:10

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Modern Cosmogony

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A. Introduction

1. Cosmogony.

For as far back as written records allow us to go, we find that men have always been interested in the origin of the universe. The area of investigation and the beliefs concerning the origin of the universe are generally termed *cosmogony*.[1] This word is derived from the Greek word *kosmos* (world) and the root of the Greek word *gignesthai* (to be born).[2] Thus cosmogony is seen to be a sub-discipline within the area defined as cosmology, which is the study of the general character of the universe.[3]

2. Early beliefs.

Much speculation in religions and philosophies has centered on the question of how the world came to be: (1) whether it was eternal, or (2) whether it had a beginning; and if the latter view is assumed, how it originated.[4] Historical and archaeological investigations have given us detailed information on the early cosmogonic beliefs of many groups including Babylonian, Buddhist, Central American, Chinese, Egyptian, Greek, Indian, Iranian, Japanese, Mohammedan, North American, Roman, South American, and Teutonic ones.[5]

Most of the early cosmogonies were mythological, assigning the creation of the world to animals or gods, and using preexisting materials such as living creatures, water, slime, or vapors. One of the oldest and most interesting of such accounts is the Babylonian one, which dates back to at least 1600 BC.[6]. Another example is afforded by the *Theogony* of the Greek Hesiod from the ninth century BC.[7] The idea that the world was made from the parts of a giant's body occurs in early Vedic and Teutonic hymns.[8] Very few early creation myths convey the idea of creation without the use of previously existing materials.[9]

3. Transitional beliefs

Six centuries before Christ the Ionian philosophers of Greece questioned the previous mythologies, and cosmogony passed into the realm of philosophy. This group believed that the world came from some "simple stuff" which arose by natural causes and then separated into various parts.[10] About 200 years later Plato wrote that the world was formed out of four eternal elements (fire, air, earth, water) by the action of a supernatural being.[11]

The next important advance was not made until 1692, when we find Newton commenting on the origin of the sun and the stars. He believed that finely divided matter had been evenly dispersed throughout an infinite space. This matter then proceeded to group together to form an infinite number of bodies. Gravity was said to be the agency of the grouping.[12] In 1775, Kant gave assent to Newton's ideas, making some small changes in minor points.[13] In 1796, La-Place set forth his "nebular hypothesis," which was to last for about 100 years. In essence, it represented no basic alterations in the original act of formation, but some details about the genesis of the planets were changed. [14]

4. Recent beliefs.

When the theory of relativity had been developed sufficiently, it was applied to the universe.[15] Einstein in 1916 first set up a model universe which was finite in extent.[16] It was static in that it would remain unchanged over a long span of time even though developments in relatively small regions such as galaxies could occur. This universe was filled with matter at rest. But the model was found to be too small to represent the actual universe.

Less than a year afterwards, de Sitter formulated another proposed model of the universe.[17] This model was both static and finite. A particle of matter placed in it would be repelled from the origin, but there was one insurmountable difficulty. The model would work only if the universe were absolutely empty.

A few more years passed, and then Friedmann and Lemaitre reworked Einstein's model, considering non-static solutions.[18]. They developed relations which allowed the conclusion that the slightest disturbance would cause the universe either to contract or to expand. Such was the status of cosmological theory toward the end of the 1920s.

5. Prospect.

Since 1920, numerous observations have been made on the universe.[19] These have necessitated some radical changes in our views on cosmogony. In succeeding sections of this discussion, we will consider the observed facts as of today, the two major interpretations of these facts, and Scriptural statements bearing upon the facts and their interpretations.

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B. Cosmological Observations

1. Introduction.[1]

When we attempt to analyze the method whereby we arrive at a certain knowledge of any natural phenomenon, one of the most difficult tasks is that of distinguishing between observations as such and the interpretations that we place upon them. These interpretations occur so rapidly, even subconsciously or automatically, that the transition from what we see to an understanding or interpretation of what we see is experienced as a process without stages, so as to almost defy analysis. The problem is farther complicated by the fact that as we mature the interpretations of earlier observations become so integrated with successive observations that we can hardly find any demarcation between observation and meaning except in those cases involving novel or unique events and experiences.

However, to make this distinction clearly becomes very necessary whenever we require to pass in review the conflicting opinions and conclusions of men with respect to the same set of observed natural phenomena. Such is the problem we now undertake, and the following discussion is aimed at setting forth in some separated form the information that comprises the observations, and only the observations, that men make of celestial phenomena.

2. Instruments and methods.

All celestial observations are made by means of radiation, since radiation is the principal physical entity that passes between celestial bodies. Thus optical instruments and optical methods become the chief concern of the astronomer. The primary instrument is the telescope, the function of which is to intercept far more light than can be admitted by the eye. The telescope utilizes the light by forming an image of the distant object. This image can be scrutinized visually with an eyepiece or recorded permanently on a photographic plate. The tremendous advantage of the photograph is that it can accumulate light throughout a long time exposure and thus record the light of objects too faint to be seen with the eye. A distance scale applied to the photographic plate will yield information which can be transformed into angular measure. A measure of the photographic density on the plate can be transformed into a measure of brightness, giving due regard to color and any filters used.[2]

The character of the light received from a distant object is analyzed by means of a spectroscope, which separates light into its component wavelengths or colors. The spectroscope gaves a measure of the various wavelengths of light present and their relative intensities. A spectrograph, making a permanent record on a photographic plate, is normally used as an accessory to a telescope.[3]

The overall radiation received from a celestial object is usually measured by means of a photoelectric cell, which gives a measure of brightness, and by means of a bolometer, which gives a measure of temperature.[4]

3. Measurements of distance.

For objects relatively near, trigonometric techniques are used in measuring distance, although the order of discrimination involved taxes the limits of accuracy of the mechanisms supporting and guiding our larger telescopes. The parallactic displacement of the near stars against the background of the general star population is better observed and more accurately measured by means of photographs taken approximately six months apart. Acceptable measurements of this type can be made of distances to about 5000 stars which lie

within a radius of a few hundred light years.[5]

For stars beyond the range of trigonometric parallax, other methods are employed. The apparent brightness of a star (its apparent magnitude) depends upon its intrinsic brightness or absolute magnitude and its distance. The absolute magnitude of a star is its apparent magnitude if seen from a standard distance of 10 parsecs or 2.6 light years. Among those stars whose distances are determined by parallax, a study of the distances and apparent magnitudes leads to a determination of the absolute magnitudes. A further study leads to a definite relationship between absolute magnitudes and star types as revealed by the spectroscope. Thus the spectral type of a star becomes a measure of absolute magnitude, and the distance can be calculated by measuring the apparent magnitude.[6]

The brightness of many stars undergoes periodic changes. These variable stars are of several types, but it is the type known as the Cepheid variables that becomes significant in measurements of distance. The Cepheid variables are very bright stars, and the period of their variations in brightness is remarkably constant. Their characteristic light curves obtained by plotting apparent magnitude against time makes for easy identification. The amazing fact about these stars is the relationship between the period of variation in brightness which ranges from 1 to 50 days and the absolute magnitude. The longer the period, the brighter is the absolute magnitude. Once identified by the periodicity of the light curve, the distance is obtained as in the previous case involving apparent and absolute magnitudes.[7]

4. Measurements of velocities.

The transverse motion of stars across our line of sight is a function of the star's angular velocity and distance.[8] The measurement of motion along our line of sight, either toward us or away from us, requires a less direct approach. When a luminous source is approaching an observer, the light waves pack so as to produce an effect of shortening of the obscured wavelength. The observer thus sees the light as more blue than normal. On the other hand, light waves from a luminous source receding from the observer, stretch out so as to produce an effect of lengthening the observed wavelength. The observer then sees the light as more red than normal. This change in observed wavelength that is produced by radical velocities with respect to the observer is known as the Doppler effect or Doppler shift.[9]

5. The Milky Way.[10]

Both visually and photographically, the Milky Way is observed to be myriad hosts of stars. Measurements of distances and velocities, together with the observed angular distributions, show that the Milky Way is a vast system of stars, of which our sun is but a feeble member. This system of stars occupies a region of space roughly lens-shaped. Its overall diameter is approximately 80,000 light years, and its thickness at the center is about one-fifth this distance. This world of stars contains an estimated one hundred billion suns, with a concentration of population near the center of the system. The central nucleus of suns which would otherwise be gloriously bright is obscured from our view by vast clouds of dust and dark material which lie along the central plane of the system. It is of interest that recent observations with radio telescopes show this center to be a strong source of radiation whose wavelength is too long to be obscured by the intervening matter.

6. Other galaxies.

Our Milky Way system is but one galaxy of stars among many such galaxies. As we look out between the stars of our own system, we see very little beyond them but empty space. However, at least one of the heavy patches of light we see in the night sky turns out to be, when photographed, a huge system of stars similar to our own. There are many others, too faint to be seen with the unaided eye. Their distances away from us as well as their distances apart are very large compared to the dimensions of each system. Therefore, they have been called "island universes" and they comprise the structural and organizational units of the matter of the universe. Each such system, like ours, contains several billions of suns.[11]

7. Distribution of galaxies.

The galaxies are distributed throughout space as far as telescopes can photograph them. They appear alone, in pairs, and in clusters. We see more of them at right angles to the plane of our galaxy than along the plane because of the large amount of interstellar matter within our galaxy which obscures the faint light of distant galaxies. When allowance is made for local bunching, and the angular distribution with respect to our galactic plane is considered, the general distribution of galaxies in space is homogeneous, or we may say the density of population of galaxies is uniform.[12]

Distances to the galaxies are measured by means of the Cepheid variables observed as individual stars in the thinly populated regions of some of the nearer galaxies, and also by magnitude measurements of a particular class of blue stars. The Great Nebula in Andromeda, our closest large neighbor, is thus determined to be about two million light years away. Our galaxy and the Andromeda galaxy are members of a local group of about fourteen. Beyond the local group, the nearest galaxies are those in a group in the direction of Virgo. This cluster contains about 500 galaxies and is situated approximately sixteen million light years away. In the direction of the constellation Coma Berenices is a cluster of over 2000 galaxies which is roughly ninety million light years

distant.[13]

Individual stars have been observed in the galaxies of the local group and in some of the galaxies of the Virgo cluster. Most galaxies, however, are too far away for individual stars to be resolved on the photographic plate, and other means must be utilized in determining distances. Such a means is the general overall brightness of galaxies. Unlike individual stars, whose absolute magnitude varies throughout a range of a million or more, the absolute magnitudes of entire galaxies have a much smaller range, which is from one-half the average to about twice the average for most galaxies. Thus a study of magnitudes of galaxies within the range of distances determined by means of individual stars in them yields a statistical method of determining the greater distances to fainter and yet fainter galaxies.[14]

The number of galaxies within the range of the Mt. Palomar telescope now exceeds five hundred million. These are within a radius of about one billion light years, and they appear to be distributed uniformly throughout space.[15]

8. Types of galaxies.[16]

Photographs of galaxies reveal many different types. Several attempts have been made to classify them. The most accepted scheme regards them in four general categories: elliptical, spiral, barred spiral, and irregular.

The irregular galaxies exhibit no structural pattern which would allow further type subdivisions, except for the general stellar density. The barred spirals have spiral arms streaming from the two ends of an extended rigid-appearing central bar. The spiral galaxies show a winding spiral structure throughout, and are distinguished from each other by compactness or tightness of the spiral arms. Three degrees of tightness are recognized. The symbol Sa is used for the most tightly wound spirals, Sb and Sc designating successive degrees of openness in the spiral arms. The barred spirals are designated by the symbol SB with subtypes a, b, and c as in the case of spirals. The elliptical galaxies are further classified as to their apparent sphericity or lack of it. The symbol EO is used to designate a spherical galaxy or an ellipsoidal galaxy presenting a circular face. Other symbols from E1 to E7 are used to designate the varying degrees of flattening. An E7 galaxy is seen edge on and would appear circular if viewed at right angles to its central plane.

A further distinction should be noted. The spiral galaxies contain much obscuring matter, such as nonluminous gaseous material and dust clouds, and are surrounded by a swarm of several hundred globular star clusters, similar in many respects to our own galaxy, which is a type Sb spiral. The elliptical galaxies, on the other hand, are relatively free of interstellar matter, are attended by few or no globular clusters, and show a symmetrical distribution of stars from the densely-populated center to the thinly-populated outer edges.

Within a cluster, the galaxies may be of more than one type. In pairs of galaxies, both may be spirals, or both elliptical, or one spiral and one elliptical. In multiple clusters, all types may be represented. In our own local group, there are three spiral, six elliptical, and four or five irregular galaxies. The spirals (our galaxy and two others) are large, luminous, and contain many stars in contrast to the elliptical galaxies which are smaller, not so luminous and contain fewer stars.

About seventy-five per cent of all observed galaxies are spiral, about twenty per cent elliptical, and the remaining five per cent are irregular.

9. Light from galaxies.

When we investigate the character of the light received from galaxies, there are two principal observations to be made with the spectrograph. One is the presence and relative intensity of particular wavelengths of light which identify the chemical elements responsible for the light. The other is a comparison of these measured wavelengths with measurements of light from the same elements near at hand in close stars or in the laboratory.

We might have expected that the light from a galaxy, originating in so many stars of different spectral types, would be a composite smear or a continuous spectrum without recognizable lines on the film of the spectrograph, but such is not the case. In spite of the fact that the light of the brilliant blue stars is quite different in character, the pattern of light from most galaxies is very much like that of the light from our sun. Now the bright blue stars are relatively few in number, and are seen in the outer regions of a galaxy. However, the light of more numerous red and yellow stars in the bright center of a galaxy predominates, giving an overall quality of light which approximates that of a small yellow star such as our sun. In the spectra of a great number of the galaxies, there a few well defined absorption lines strong enough to afford wavelength measurements on the photographic plate. The lines ordinarily used are the so-called H and K lines of calcium situated in the blue region of the spectrum.

In the case of star spectra, it has been indicated that a change in observed wavelength of a spectral line is a measure of radial velocity, toward the observer if the shift is into the blue end of the spectrum, away from the observer if the shift is toward the red end of the spectrum. The radical velocities of thousands of stars within our galaxy have been measured in this way. These velocities are of the order of several hundred miles per second.[17]

When the same general technique is applied to the spectra of galaxies, a problem is raised which becomes of prime importance to all other questions in cosmology. The problem arose in the following manner. Between 1912 and 1924, Slipher, of the Lowel Observatory, investigated the spectra of 43 galaxies, and found a shift toward the red in 38 of them. He also found that the shift was more pronounced for the fainter galaxies, the corresponding radical velocities amounting to as much as 1200 miles per second.

Humanson and Hubble at Mt. Wilson followed this with an intensive investigation of the red shift in the spectra of galaxies. They showed successively that the shift increased with faintness and therefore the shift increased with distance. The necessary conclusion was that the galaxies are receding from us, and with radial velocities proportional to their distances. In other words, the farther away from us a galaxy is observed, the faster it is moving away from us, and the velocity we observe becomes a measure of distance. The universe is expanding.

This conclusion was not readily accepted. There were doubts and objections. Is the red shift an observation of radial velocity? Is radial velocity an erroneous inference from observational data which required some other explanation? As long as the Doppler shift indicated the modest velocities of stars in our own galaxy, no one doubted that it was a valid measure of velocity. Such measured velocities were welcome information in piecing together a picture of the dynamics of our galaxy. However, as soon as large velocities were required to match a large displacement of the spectral lines, many minds rebelled. Confidence in the Doppler effect was shaken. Other interpretations were attempted, but in time abandoned.

The observational data remain. It is a hard fact that the H and K lines of calcium are displaced on the plate of a spectograph when the spectrum of a faint galaxy is photographed. The shifts are measured with a millimeter scale, which is one of the simplest acts of measurement to be made. According to the Doppler idea, the distance measurement is indirectly a valid measure of radical velocity. No suggested alternative has been able to survive the fierce criticisms and conflicting opinions of the past generation to the extent of commanding the respect of many who think upon these things.

The work of the Mt. Wilson and Mt. Palomar telescopes have greatly extended the observed values of velocities of recession. Several measured values are of the order of 50,000 miles per second. It is estimated that in the future the Palomar telescope may be able to see galaxies with a velocity of recession of 100,000 miles per second, or more than one-half the velocity of light. This corresponds to a distance of about 2 billion light years.

What will the result be when even greater velocities are observed? What will the Doppler shift in spectra of galaxies receding with almost the velocity of light be? Calculations show that this shift would be from the extreme blue end of the spectrum to the near infrared, a shift well within the photographic range of a grating spectograph. Finally, any greater value of the velocity of recession than the velocity of light could not be observed at all, since the light from such a source could never reach us. Thus the observable universe is limited to a radius of about 5 billion light years.[17]

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C. The Hyperdense State Theory . . . . 10pt bf cent

1. Introduction.

The recognition of a universe which is expanding has led to several interesting theories of its age and origin[1]. Although there are many variations of theories based on the concept of an expanding universe, there are two general groups which may be considered as major contributions to cosmogony. The first is the group consisting of the ideas of Eddington, Lemaitre, Gamow, and von Weiszsacker[2]. The other is the

group consisting of the ideas of Bondi, Gold, and Hoyle[3]. Both of these groups of theories accept the expansion of the universe as a fact, but place quite different interpretations upon it when it is considered with certain assumptions and other observational data.

The first group of theories proposes a beginning of the universe at a particular time in the remote past. The second group postulates a universe of infinite duration[4].

It in now our purpose to set forth the tenets of the first group of theories, regard them as one general theory, and then proceed to examine this general theory with respect to the observed data it purports to explain and with respect to the several objections that have been raised against it.

2. Statement of the theory.

Briefly, the sequence of ideas which comprises a cosmogony calling for a universe of finite duration is as follows. (1) Many processes taking place in nature are irreversible in character, and therefore could not have been taking place for an infinite period of time[5]. (2) Assuming the laws of physics are valid throughout both space and time, extrapolations can be made in the cases of a number of such processes showing a finite duration for each. Calculations reveal a remarkable consistency of values for the time of the beginning of these processes[6]. (3) The expansion of the universe could have proceeded only from a very compact and highly dense state at a time ago which agrees with the time calculated by examining other natural processes[7]. (4) Applying the laws of physics to such a hyperdense state of the universe, the present condition of the universe can be accounted for in many of its details[8].

3. The nature of processes.

The unceasing and inevitable changes in nature are apparent to all. "Change and decay in all around I see" are the words of the familiar hymn. Some of these changes are cyclical processes, recurring phenomena, such as the circulation of water from ocean to atmosphere to land to ocean again, or the revolution of the planets about the sun. Some natural processes are reversible in character, such as the condensation and evaporation of dew.

Most changes in nature, however, are observed to be taking place in one direction only, and if our scale of time and space are large enough, perhaps all are[9]. The planets are slowing down. The sun is cooling off. Given enough time, the temperature of the earth will be too low for the water cycle to operate as it does today.

Such processes occur simply because there is a finite amount of matter involved in these changes, or because there is but a finite amount of energy associated with each process to maintain it. The entire matter of the universe is not included within any one set of events that go to make up the activity of the universe. Neither is the total energy of the universe available for maintaining any one set of events.

If it can be shown that a particular process involves a finite quantity of energy and a finite quantity of matter, then such a process must be irreversible, and therefore must run its course from a beginning to an end. A study of rates should reveal something about the duration of the process.

4. Age determinations.

There are roughly three groups of phenomena which may be examined in such a way as to permit a calculation of age. The first group pertains to earth processes and yields an age for the earth. The second group involves stellar processes and yields an age for our galaxy. The third group involves intergalactic relationships and yields an age for the universe. One of the best and most complete reviews of these various age determinations was written by D. ter Haar late in 1953.[10] The results of these age determinations are briefly outlined below.

(1) Cooling of the earth's crust. The rate at which the earth's crust must have cooled from a molten state to its present temperature, giving due consideration to the presence of radioactive materials, leads to an age for the earth of from 2 to 4 billion years.[11]

(2) Salinity of the ocean. The present amount of salt in the oceans and the rate at which salt has been carried to the ocean allow calculations which give an age for the oceans of 4 to 7 billion years.[12]

(3) Formation of sedimentary rocks. The rate at which igneous rocks have been changed into sedimentary rocks yields an estimated age for the earth of 3 to 4 billion years.[13]

(4) Radioactive element presences. The presence of radioactive uranium (235 and 238) and thorium (232) in appreciable quantities now indicates that the earth cannot be older than about 10 billion years.[14]

(5) Isotopic ratios. The present ratio of the uranium isotopes (235 and 238) and the present ratios of several lead isotopes give a value for the age of the earth of from 3 to 6 billion years.[15]

(6) Decay products. A study of the ratios of uranium and thorium to lead and helium in ores gives a value of about 3 billion years for the age of the earth.[16]

(7) Recession of the moon. The counter effect of tides upon the moon increases the moon's angular velocity and therefore its distance from the earth. Studies of the rate of recession of the moon from the earth yield a time of from 2 to billion years ago for this recession to have started.[17]

(8) Age of meteorites. An examination of the uranium, lead, and helium contents of meteorites which fall to the earth gives an upper limit of 7 billion years for the age of meteorites.[18]

(9) Distribution of stars among stellar classes. From the spectra of stars we learn of their compositions, particularly the ratio of hydrogen to helium in their atmospheres. This ratio is thought to change throughout the history of a star. The distribution of stars among the various spectral types found in the main-sequence stars is the basis for computing an upperlimit for the age of the stars of 100 billion years. The methods used do not include white dwarfs, red supergiants, and others not in the main-sequence. An age determination based upon stellar evolution is therefore very uncertain at our present stage of understanding of the processes involved.[19]

(10) Distribution of kinetic energy among stars. A study of the physical properties of the stars (mass, period of variable brightness, spectrum) and their motion within the galaxy reveals certain correlations which indicate a relationship between physical state and kinetic energy. On the basis of rather meager data, the age of our galaxy is estimated to be of the order of a few billion years.[20]

(11) Separation in binary systems. The separation between the two component stars of a binary system is thought to increase with time, due to gravitational interaction with other nearby stars. A study reveals that for greater separations there are fewer binaries, thus pointing to an age for our galaxy of not more than 10 billion years.[21]

(12) Openness of star clusters. A typical open star cluster, as distinguished from a densely populated globular cluster, is undergoing a disintegration which will lead to a random dispersion in about 2 or 3 billion years. A study of the number of clusters and their present degree of openness leads to a value for the age of our galaxy of from to 5 billion years.[22]

(13) Galaxial clusters. Galaxies are found to occur in clusters. The density of population of galaxies within such a cluster is considered as an indication of the age of the cluster. A study of their density distribution leads to an estimated age of the universe of from 2 to 4 billion years.[23]

(14) Velocities of galaxial recession. Since the dis tance to a galaxy is proportional to the velocity of recession, as revealed by the red shift, it follows that as we consider more remote times in the past, the galaxies were closer together. A calculation based on the value of the red shift indicates a universe of small volume and high density about to 5 billion years ago.[24]

Thus it is seen that of the fourteen different approaches to the determinations of the ages of the earth, our galaxy, and the universe, only one leads to a value which is anomalous, and this is the most uncertain value of the group. All the rest lead to values that are remarkably consistent, even to values that are of the same order, namely 1 to 10 billion years. It hardly seems possible that this is mere accident.[25]

5. The beginning.

Assuming that the total amount of matter and radiation in the universe is a constant throughout time, an expanding universe could not have expanded forever. Either the universe as we now see it is a particular phase of an oscillating universe, or it must be the result of a unique event, which may be termed as beginning.[26] Various models of an oscillating universe have been proposed[27], but none calling for short period or small amplitude oscillations.

The universe cannot be static insofar as the distribution of galaxies in space is concerned, unless there exists a force exactly equal and opposite to gravitation.[28] The arbitrary assumption of such a force of repulsion was a feature of an early model proposed by Einstein, but later abandoned. In the absence of such a force, the universe would eventually collapse as a result of mutual gravitational attraction, or would expand without limit if the velocities of recession were such as to overcome gravitation The latter is declared to be the case,[29] since the kinetic energy due to gravitational attraction, as shown by the red shift. Thus gravitational interaction can never in the future slow down the receding galaxies nor ultimately produce a general collapse. The expansion of the universe is irreversible.

Obviously such an expansion could not have proceeded from any thing like the present state of affairs in the universe.[30] The age-velocity-distance relationships revealed by our observations indicate that the present process has been going on for quite some time, and that the universe was formerly much smaller than it is today. We assume that this process of expansion is a continuous one, since there is no evidence of any discontinuities this side of the absolute limit, which is a universe of zero radius and zero age. Thus the irreversible and continuous expansion of the universe must have had a beginning.[31]

6. The hyperdense state.

Calculations based upon the laws of physics can be made which give us some ideas of the nature of the universe when it was very small and very young. These calculations assume the conservation of the sum of matter and energy, as well as the validity of other physical laws. Let us now consider some of the ideas to which such calculations lead.

Eddington and Lemaitre postulate a small exceedingly dense body of matter which expanded or eploded into the present universe.[32] The density of this primordial lump, or "primeval atom" as Lemaitre called it, was of the same order as the density of the nucleus of an atom, or about 100 million tons per cubic centimeter. At this density all the matter of the known universe would be contained within a sphere about the size of the planet Mars. The terrific forces

inherent within such a densely-packed conglomerate of particles brought about its disintegration and explosion. The resulting fragments were not homogeneously distributed in space at any given subsequent time and this turbulence allowed gravitational attraction to bring about an association of particles into clouds of material which later became galaxies. The temperature of the initial explosion would be very high—higher than exists anywhere in the universe today, even considering the interiors of stars. At such temperature all material particles would be radioactive in character and may well be considered as light quanta, rather than matter. Lemaitre suggests the initial process as being the emission of quanta of fantastically high energy and frequency which gave birth to material particles in the subsequent expansion. In other words, the universe began with an exceedingly intense burst of light.[33]

Gamow developed this idea further and showed that the density of radiation decreased faster in an expanding universe than did the density of matter.[34] Near the beginning therefore, the density of radiation exceeded the matter density, the universe being almost entirely radiative in its initial stages. Thus during the first 5 minutes of this expansion, the universe was a mixture of as yet undifferentiated radiation and matter with radiation outweighing matter. Somewhere between 5 minutes and 30 minutes, the matter density became greater, and elemental particles began to coalesce into heavier atoms. The theory proposes that in this super-hot explosive mixture of radiation and matter conditions were such as to provide the opportunity for the formation of the elements in the relative abundances we find throughout the universe today.[35] Gamow dodges the issue of an ultimate beginning by assuming a universe that spent an infinity of time contracting into this hyperdense state about 5 billion years ago, from which it is now expanding and will continue to expand for an infinite time.[36] However, one should be careful to recognize that the nature of the hyperdense state was such as to prevent us from knowing anything at all about such a previously existing universe, and even makes its very existence purely conjectural.[37]

7. Summary.

This general theory of the hyperdense state has many attractive features. It contains no assumptions just to make the theory work. It proceeds from observations, and by means of deductive and inductive reasoning arrives at a conclusion which is consonant with many of the known facts of the universe. It does not call for the violation of any presently-accepted physical law. It accounts for the recession of the galaxies, the ages and abundances of the elements, and several other observed phenomena. The theory calls for a universe which behaves according to the second law of thermodynamics. It presents a universe which may be described by one of the models allowed by a corrected general theory of relativity. Finally, this theory has withstood the many objections which have been raised against it.

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D. Continuous Creation

1. Introduction.

In 1948, Bondi and Gold,[1] as well as Hoyle,[2] set forth a steady-state theory of the universe. Since then the idea has also been treated theoretically by McCrea,[3] and several semipopular articles[4] and popular articles[5] on it have appeared. In addition, Hoyle has written a popular book[6] which has had a wide circulation. The basic idea says that all the matter of the universe is the result of a process of continuous creation which is proceeding in all places and at all times. The matter as it appears is then thrown out into infinity by expansion, clumping up in the process.

The major implications of the idea are that the universe is not the result of one unique event of creation at some time in the past, that the universe is infinite in extent, that it has existed for an infinite past time, that it will continue to exist for an infinite future time, and that creation of matter is a continuous process. The idea of contiuous creation is not a new one, having been proposed in various forms previously by both philosophers[7] and scientists.[8]. But never before has the idea received as wide a consideration.[9] In fact, some think that these newest proposals may serve to initiate a new era in cosmology.[10]

2. The cosmological principles.

Almost every theory of the universe has treated it as if it were homogeneous, that is, as if the contents could be regarded as a continuous distribution of a constant density fluid. Every observer would thus see the universe as symmetrical with respect to himself. This hypothesis of the homogeneity of the universe has been called the cosmological principle.[11] The exponents of this recent steady-state theory have extended the cosmological principle. They assume that the universe is also homogeneous in time, which means that an observer sees the same thing regardless of when he looks out at the universe. This extension has been termed the perfect cosmological principle.[12]

3. The observational limit.[13]

As has been previously indicated, the most accepted idea concerning the galaxial red shifts is that the universe is expanding. The rate of expansion (which is proportional to the distance) is such that this rate becomes equal to the speed of light at a distance of about 5 billion light years. At this distance, then, we have an observational horizon, beyond which we will never be able to see. All objects beyond that distance are receding with speeds greater than that of light. Therefore, their light can never reach us, because the distance is stretching more rapidly than the light can travel. Thus there is a cosmic curtain which makes a secret out of all things on its far side.

4. Preliminary ideas.[14]

According to the hyperense state theory, all the galaxial material must have been concentrated in a relatively small region about 5 billion years back. An explosion then occurred, and the initially compact universe went flying out into all directions. Eventually, as far as science can foresee, an observer in our galaxy would be able to see no other galaxy, all of them having passed to the other side of the cosmic curtain.

These hyperdense state ideas satisfy the cosmological principle, but they do not tie in with the perfect cosmological principle. The reason is that a universe based on the hyperdense state theory does not appear homogeneous in time. According to this theory the mean density of the universe will decrease with time. The only way to keep the density constant (and to preserve the idea of expansion) is to assume that matter is being continually created in space.

5. The total picture.[15]

The theory of continuous creation considers the observable universe as a unit. Galaxies are constantly crossing the observational limit, and thus are being lost to this unit. However, matter is being created in the space within this definitional unit at a rate which just compensates for the above-mentioned loss. The rate turns out to be 10-43 grams per second per cubic centimeter (mass of one hydrogen atom per billion years per litter). This implies that about 1032 tons (about the mass of 50,000 suns) are created every second in our observational unit.

As the matter is created, it begins to participate in the expansion, and as it does so it slowly condenses into galaxies. Thus while galaxies are continually reaching the horizon of observation, other galaxies are being born within it. These changes are pictured as having gone on for an infinite time. Thus the picture of the universe would be the same, regardless of when one observes it, today, a billion years ago, or even 100 billion years ago. Change in detail is occurring, but from a large scale point of view, the picture remains constant. Any individual galaxy, star, or planet may be said to have had a beginning, but not the whole observable unit or the universe.

It is proposed that the universe acts as a sink of radiactive energy, this sink supplying the energy of expansion. Photons emitted by stars travel through

space until they are absorbed by matter. The emitting star and the absorbing matter are receding. Thus the frequency of the photon as seen by an observer on the absorbing matter will be reduced. The energy that it imparts to the absorbing matter will be smaller than that it removed from the star. The difference is what is postulated to flow into the radiative sink.

6. The created matter.[16]

The proposed created matter would be electrically neutral, for if it were not it would repel itself. One might also expect a simple form of matter. The three major contenders seem to be: (a) protons and electrons created separately, (b) hydrogen atoms, and (c) neutrons. The creation of hydrogen atoms is preferred by almost all supporters of the theory.

The creation of matter is pictured as "out of nothing." It is viewed as a true creation, not as a shaping or forming of pre-existing material, or even as a conversion of energy into matter.

7. Tests of the theory.

It is unfortunate that the two major ideas involved in the theory of continuous creation do not lend themselves to measurement. The rate of creation of matter is so small that it cannot be observed.[17]. Also, in order to test the idea of the homogeneity of the universe in time (to see if the density is decreasing or remaining constant), at least a billion years would be needed.[18]

Many workers believe that the best experimental approach for testing the Bondi-Gold-Hoyle hypothesis is a study of galaxial ages.[19] The continuous creation theory prodicts a mixture of galaxies of various ages at all distances from an observer. The hyperdense state theory postulates that all galaxies (or at least the material of the galaxies) have the same age. Exponents of both theories have claimed that the present data upholds their ideas, but the fact seems to be that we are not yet able to date galaxies with a high degree of certainty.[20] In 1948, Stebbins and Whitford[21] found that elliptical galaxies show extra reddening (in addition to the red shift), while spiral galaxies do not. The extra reddening increases with distance. This extra reddening is generally thought to be due to the presence of more red and less blue stars in the elliptical galaxies. If this view is correct, then the excess redness of the elliptical galaxies is due to the fact that we see them now as they were in the distant past when they were much redder. Such an interpretation would mean that galaxies in the past differed from those of today, which contradicts the Bondi-Gold-Hoyle hypothesis.[72]

One of the most important things that any cosmological theory should be able to explain is the observed abundance of the chemical elements.[23] The hyperdense state theory holds that the elements were generated in their present day abundances during and just after the initial explosion.[24] In the theory of continuous creation, some method for the production of the heavier elements from hydrogen which is occurring today is required.[25] Only one process has been proposed, namely, that the heavy elements are products of supernova explosions.[26] There are at present many unsatisfactory features of this proposal, one being that supernova are too rare to give the observed abundance curve, another being that different conditions must be chosen to explain different regions of the abundance curve.[27]

One of the starting points in the development of the recent theory of continuous creation was a discrepancy in the age of the universe (calculated to be about 2 billion years) and the age of the earth (calculated to be over twice this number of years).[28] Recent investigations, however, have pointed out an error in previous age determinations of the universe.[29] and the age has been revised to about 5 billion years, which fits very well. In fact, ter Haar feels that the almost exact agreement of the ages of the earth the moon, the sun, our galaxy, and the universe constitutes a strong argument against the Bondi-Gold-Hoyle position of belief.[30]

A few other points have been advanced by various writers, these points either claiming to substantiate the hyperdense state theory or to negate the continuous creation theory. These include galaxial sizes,[31] cosmic rays,[32] and the ratio of visible to invisible matter [33] In general, none of them comes near to being conclusive.

8. Philosophical aspects.

Dingle, in several articles,[34] has severely criticized the philosophical basis of the theory of continuous creation. He points out that the cosmological principle is supported by some evidence and should be called the cosmological assumption, but that the perfect cosmological principle is supported by not one experimental observation and therefore should be called the cosmological presumption. Dingle says that science has generally accepted that no statement about nature should be made for which there is no evidence, but that recent investigators (including Bondi, Gold, and Hoyle) have operated on the principle that any statement may be made which cannot immediately be refuted. The theory of continuous creation, he states, has no more basis than the fancy of a few mathematicians who have concluded what they wanted in a universe, and then have set out to fit mathematical relations to their preconceived ideas. Dingle argues that the final court of appeal in science must always be experimental observations, and as of now, the Bondi-Gold-Hoyle hypothesis has not even presented itself in court. Dingle may perhaps be too critical, but his ideas cannot be discounted, since he is widely known in the field of the philosophy of science, and is acclaimed for his clarity of thought.

It is also of interest to note that the theory of con-

tinuous creation would force us to modify several of our basic principles, namely: (a) physics recognizes no process capable of building up nucleons (protons and neutrons) from any immaterial form of energy or from nothing, neither any process of annihilation of nucleons;[35] (b) the overall entropy of the universe has been held to be increasing, but in the theory of continuous creation, it would remain constant;[36] (c) the law of conservation of matter and energy, since matter is purported to be in continual creation.[37] It thus appears that the Bondi-Gold-Hoyle hypothesis creates more problems than it solves. Not that the three ideas mentioned above should be held to be above examination and criticism, but it does not seem proper that an idea which has no direct observational foundations should be allowed to supersede three ideas which are based upon extrapolations of numerous experimental evidences.

A word concerning the popular work of Hoyle[6] might be in order as a conclusion to this paper. Almost all of the scientists who have reviewed this work strongly caution the reader against believing everything that Hoyle asserts.[38] They feel that he dogmatizes too much and that he mixes well-tested conceptual schemes, broad working hypotheses, and purely speculative notions without bothering to erect any guideposts. One writer makes the interesting comment about the idea of continuous creation as presented in Hoyle's volume that every physicist would probably believe in creation if the Bible had not said something about it years ago.[39]

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E. Scriptural View

1. Sources of knowledge.

Final answers in the matter of creation cannot come from research (science) or reason (philosophy).[1] Science can observe, systematize, and interpret changes, but it does not lend itself to final or ultimate pronouncements in the realm of origins. Neither can reason make terminal statements on cosmogony. If however, God exists, and if He has chosen to reveal to mankind information about the origin of the universe, there is another source of knowledge that can

be appealed to, namely revelation. Christians believe that God has spoken to men, and that He has communicated to us in the Biblical revelation a doctrine of creation, including some pertinent information on cosmogony.[2]

2. Biblical language.

The language of the Bible with reference to natural phenomena (including cosmogony) is not that of modern-day science.[3] The language is popular, phennomenal, and often poetical or metaphorical. This, however, does not prevent us from recognizing the basic Scriptual view of cosmogony. It is well also to remember that the major purpose of the Biblical writings is spiritual, and not scientific.

3. The Biblical passages.

The basic Biblical pronouncement concerning the creation is Genesis 1:1,[4] which reads, "In the beginning God created the heavens and the earth." Another very important passage is Hebrews 11:3,[5] stating "By faith we understand that the world was created by the word of God, so that what is seen was made out of things which do not appear." Many other Scripture passages support and amplify these.[6] When all these are read, it is obvious that the message they carry is that the whole universe is dependent upon God for its beginning and continued existence.[7]

4. Time and eternity.

The first phrase in Genesis 1:1, "In the beginning," is extremely important since it appears to involve the concept of time. The Hebrew word berashith which is involved here generally denotes the first in place, time, order, or rank when it is used in the Old Testament.[8] The Greek word *arche* is somewhat equivalent to this Hebrew word,[9] and it is used many times in the New Testament.[10] Thus the Scriptures require us to trace the universe back to a beginning or a commencement.

With regard to time, Christian theology has generally held that it was created. Since God's nature is eternal, it is asserted that He therefore must be the cause of time.[11] Thus the Bible references to the time-eternity problem may be seen to lead us to conclude that the world did not have a beginning *in* time, but that time came into existence simultaneously *with* the world.

A few writers, however, both ancient and modern, have argued that if an eternal Being acts or creates, He may (or even must) create from eternity.[12] There are several objections that have been given to this idea,[13] some Scriptural, some philosophical, and the general feeling at this time seems to be against the concept.

Thus with regard to time, the "point with time" view of creation is much more tenable than the "eternal" one from a Biblical viewpoint.

5. The nature of creation.

The second phrase in Genesis 1:1, "God created," is also of import since it appears to deal with an act itself. The Hebrew word for create *bara* does not necessarily mean creation without the use of preexisting materials, although it may.[14] Nonetheless, consideration of the context and of other Scripture passages[15] indicates that the Biblical doctrine of creation involves the concept of *ex nihilo* creation. This means that matter is not eternal; nor is time, nor is space, for God is said to be Creator of all things.[16]

6. The universe.

Consideration of the third phrase in Genesis 1:1 "the heavens and the earth" is now in order. The Hebrews had no single word for the universe, the nearest approach to it being the phrase "the heavens and the earth."[17] The Hebrew words (*shamayim, erets*)[18] do not exactly convey the modern idea; for the uninspired Hebrew of Biblical times, the earth was central and the heavenly bodies were mere adjuncts.[19] Two interpretations are possible: (1) that the phrase refers to the whole universe, or (2) that it refers to an immediate vicinity (whether this is the solar system, a local star cluster, this galaxy, or some other real or imagined unit). The former interpretation seems more reasonable since the phrase "the heavens" would probably refer to what the Hebrew saw when he looked up into the sky at night.

Only in the New Testament do we find the universe or "all creation" distinctly referred to. This occurs in phrases utilizing the expressions "all things" (*panta*) and "the whole creation" (*pasa he ktisis*).[17]

In summary then, the most valid exegesis of the Bible's references to creation would seem to be that the whole visible and invisible universe had a beginning coeval with time, God being the one and only Creator, creating by a free act, and creating without preexisting materials.[20]

7. Entropy.

A corollary of the second law of thermodynamics deals with the concept of entropy.[21] In essence, this corollary is a recognition of the fact that the universe seems to be running down, going from order to disorder. This process is generally recognized as being irreversible. The idea has often been used as an argument for creation.[22]

The Scripture writers agree with the conclusion that things seem to be running down, for several passages record their observations, and they teach the concept in a prescientific form.[23]

8. Immanence and transcendance.

Christianity is unique in teaching both the transcendance and the immanence of God. Not only is He author of and above His creation, He also pervades everything, both organic and inorganic. These concepts are carefully balanced, to prevent deism (stress-

ing transcendance) and pantheism (stressing immanence).[24]

9. The hyperdense state theory.

This theory seems to agree quite well with the Scriptures, as has been shown by several previous authors.[25] There is a point with time that may be called the beginning, an act which could have been the creation, and the whole universe seems to have been involved.

10. The continuous creation theory.

This theory appears to be somewhat difficult to reconcile with a conservative view of the Bible. In order to do so, one would have to (1) treat the Scriptual references as entirely unrelated to reality and as purely theological in character, (2) treat the word "beginning" as allowing creation from eternity, or (3) treat the phrase "the heavens and the earth" as referring to a local situation only. Unless these approaches or similar ones are made, the idea of continuous creation cannot be harmonized with the language of the Scriptures.

In addition, the idea of entropy is involved since continuous creation will not fit into the previously held pattern of thought. Then, too, this theory might be said to overemphasize the immanence of God, although such a point is open to question. Finally, the Scriptures imply that creation in some way was terminated and the providence or sustaining activity of God took over.[26] Thus, it should be evident that there are some pronounced difficulties in acceptance of the theory of Hoyle, Bondi, and Gold and in an adherence to a conservative view of the Christian Scriptures.

11. Conclusion.

In reality, one must never forget that all our scientific ideas relating to ultimate questions of the universe come under the category of hypothesis.[27] Only relatively few facts are known about the universe.[28] From these many mathematical models can be and have been drawn up. If a model seems to a person to integrate the few known facts, then it is used to conclude many other things about the universe. But just because a model fits the few bits of observational data that we have does not mean that it is the true model. It is known that some theories which are physically false may provide answers which are not incompatible with present experience.[29] History shows that models which seemed to explain the whole universe were easily upset by just one more observed fact.[30] The universe behaves entirely independently of the attempts of men to describe it, and hence any statement based on a mathematical model can never claim the status of an observation.

No person can come to the problem of cosmogony without some preconceived ideas. The concept of creation is so basic to Christianity that it forms a substratum on which our theology is built. This makes cosmogony particularly controversial in our society Attempts to avoid the idea of creation are all through the scientific literature, indicating the presence of much prejudice. Many writers are not content to just leave the idea alone, which would be a true scientific attitude since science does not deal with origins, but they take pains to point out possibilities for an eternally-existing universe.[31]

The wide acceptance among many laymen of the ideas of Hoyle as set forth in his book might be traced partially to a desire (either conscious or unconscious) to escape the idea of creation and therefore to escape the idea of God.[31] This seems to have been a hobby of mankind down through the ages. However, most astrophysicists express serious doubts about the concept of continuous creation, preferring the hyperdense state theory at the present.

Perhaps the hyperdense state theory is true, perhaps not. Maybe we have gotten completely down the wrong trail and some other theory, not even dreamed of today, will turn out to be the correct one. But regardless of the coming and going of models and interpretations of the observed facts, we can always turn our eyes skyward and know that the heavens are telling us the glory of God and the wonder of His works.[32] With reference to our positions as scientists we must not make a premature judgment on the mechanism of creation, but as children of the Highest, we may affirm with the inspired author of Hebrews that by faith we understand that the world was created by the word of God.

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Creation

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Many things being taught our Sunday school pupils as God's Word are really only interpretations. Some of these can never be reconciled with the facts of science. Controversely many things being taught in our Universities as facts are really only generalizations from experimental observations. Some of these can never be reconciled with the Word of God. To my knowledge there is not fact of science or passage of Scripture that are contradictory to one another. The following account of creation is given from the best scientific evidence I know of today. Tomorrow parts of it may be obsolete in the light of new discoveries.

In the beginning God created the heavens and the earth. In a moment with explosive force the matter of the Universe came into existence. According to Gammow, the initial temperature and pressure was so great that the Universe was blown outward like an immense bomb. The force of this explosion was so great that the most distant galaxies visible to us are still traveling away from us at 1/5 the velocity of light (38,000 miles/second). That is when the light we see started on its way toward us, 360 million light years ago. In the first few minutes of its existence the elements of the Universe were formed from created neutrons, protons, and various forms of radiant energy. In this brief moment the present relative abundances of the elements were fixed, considering known transmutations such as the fusion of hydrogen to form helium, our source of solar energy. All matter is composed of atoms of the various elements. Water is composed of atoms of hydrogen and oxygen. Hydrogen is the smallest atom. It contains just one proton, or if it is heavy hydrogen it contains one proton and one neutron. The protons and neutrons are very dense and occupy the central nucleus of the atom. The electrons spin about the nucleus like the planets spin about the sun. Theories which require the continuous creation of matter in order to maintain a static universe, while still appearing to expand, can never be anything more than entertaining mathematical models until some process of neutron and proton creation is known.[5] Electron and positron pairs can unite to produce high energy light rays, and in turn can be formed by such rays; but there is no known way that neutrons and protons can be created or annihilated.

The earth and the whole Universe was a shapeless mass expanding with inconceivable speed. The initial flash of brilliant light had faded and it was dark and turbulent. It is difficult to imagine anything more desolate than an area devastated by an atomic blast. The word used to describe the Universe at this stage is void or a wreck. Isaiah 45:18 tells us that God created the earth not in vain, He created it to be inhabited. The matter out of which the earth will be formed is not inhabitable at this step of creation—but God is not finished! In the thinking of some, each stage of God's creative act must be perfect by *our* standards of perfection. When they read that the earth was shapeless, void and dark they conclude that it must be imperfect and hence something must have happened to destroy it. We would not consider a shapeless mass of pottery clay to be imperfect. A potter dug that clay and purified it not in vain. He intends to shape it into a beautiful piece. The earth of necessity would look desolate until it was clothed with grass and trees, and swarming with animal life.

Gradually the elements began to clump together and the larger clumps began to draw the smaller clumps into their gravitational fields. As the clumps grew to the size of stars the heat of contraction raised the temperature of the interior high enough for nuclear reactions to occur. And God said, "Let there be light", and there was light. The hot stars fueled by nuclear energy began to radiate light. Our sun (our star) was relatively recently formed from interstellar gas and dust. Our earth and the other planets in our solar system were probably forming at the same time our sun was taking shape. This step of creation (the formation of light) has reference primarily, I believe, to our solar system.

Did our sun begin to radiate in a moment of time? Or did God use the natural force of gravity and the natural forces of nuclear reactions to accomplish this result over the years and years of time such a process would require? We should not resent God's use of natural means when the laws of nature are God's laws. The force that parted the Red sea and froze a wall of ice on either side was, we are told, a wind. Let us conclude then, that the most natural means of accomplishing His purposes, is the method of God's choice. We may assume then that God used the forces of nature and the time these forces would require, to shape the Universe and our earth for habitation. Certain alternative explanations have led to impossible interpretations of other Scriptures and the facts of science in order to make them consistent, such as fossils

created as fossils, and light created half-way to the earth. These are justified on the basis that God can do anything. But there are things that God cannot do. God cannot act contrary to His own nature. Titus 1:2 plainly tells us that God cannot lie. Fossils created as such and light created half-way to the earth would be a deceptive creation, giving the impression of great age that did not exist. Insisting on fantastic ideas such as this denies the Christian Faith to the scientist.

How then must we interpret the word day and the expression, "the evening and morning was the first day", if the time God took to form our sun into a light bearer was greater than our 24 hour day? The word "day" in Scripture, is used for periods of time longer than one solar day. It is used to describe the day of Salvation which has lasted now for thousands of years, II Cor. 6:2. "Evening and morning" could be a figure of speech, like when we speak of the sun rising and setting, when we know it is the earth that is moving. It could here convey the idea of finality; but I don't know that it means this. Once the sun began to radiate, it would continue to radiate until the creation of the new heavens and the new earth, II Peter 3:13. No sin of Satan could darken it until it had finished it's course. It is held by some that a literal interpretation of "evening and morning" necessitates a literal, 24 hour, interpretation for day. This is true. But if day is used figuratively then of course "evening and morning" will also be figurative, otherwise long periods of continual dark would be indicated, which we know could not have occurred.

If this Genesis account is a recreation account some explanation of the necessity of recreating the sun as a light emitting body must be found. Is it imagined that the sun was darkened in some way so that it could not give its light? Any process such as an explosion of the sun, which could darken it would also involve and destroy the earth as we know it, and our solar system would cease to exist. Bringing order out of such a chaos would look like an original creation because no remnant of a former order would survive it. The strata require a radiant sun for their formation. The principle strata are all the result of soil erosion by water; this water is drawn up into clouds from bodies of water by the sun, and dropped as rain. Darkening the sun is obviously inconsistent with the reconstruction theory for it provides no explanation of the strata and its fossils.

God separated the light from the darkness. The earth began to rotate on its axis, and to circle about the sun in a plane at an angle to its rotation to give us our seasons. Here also we could raise the question, was the rotation of the earth on its axis reinstituted about 6-12,000 years ago after a long period of absence? By every physical criteria, the radiant energy of the sun and the rotation of the earth on its axis have continued much as they are today since their first appearance.

The evidence against a recreation seems pretty strong, but is there any evidence for it? 1. The use of the word, *re*plenish, in Genesis 1:28. It is thought that this means that Adam is to *re*inhabit the world once inhabited by a pre-adamic race of men. The hebrew word *mal'a* simply means fill, or sometimes complete.[3]

2. The description of the, "at that time", future desolation of Palestine and Jerusalem, Jer. 4:16-29. Vs. 23-26, "I looked on the earth, and lo, it was waste and void; and to the heavens, and they had no light. I looked on the mountains, and lo, they were quaking, and all the hills moved to and fro. I looked, and lo, there was no man, and all the birds of the air had fled. I looked, and lo, the fruitful land was a desert, and all its cities were laid in ruins before the Lord, before his fierce anger". The wording here sounds a little like Gen. 1:2. Some Christians have interpreted this as a literal reference to Genesis, and have used the expression, there was no man, to infer the destruction of a preadamic race, which they believe explains the ancient human fossils, such as the Java man. Paleontology indicates modern man is a descendant of fossil man. The cultural objects, such as tools, pottery, fire, art and evidence of religion, proves fossil men were truly men in our sense of the word, they were men as we are, not super animals. Only the determmination to find proof for a recreation could lead a person to twist this description of a future desolation, to a literal reference to Genesis.

3. The possibility of using "became" in Gen. 1:2. It is possible to translate the verb "to be" as became, but this is not the usual meaning and nothing in the context suggests it. If it were to mean became, linguistic usage would require that the sentence begin with the verb followed by the preposition "lamedh"[3] The Septuigant uses *was*. After a brief statement that God created the record goes on to describe *how* God shaped this creation for man's habitation.

4. Why the seventh day should be hallowed when it corresponds to a seventh era. The seventh day was given as a day of rest to commemorate God's rest from all the things He created to make.[3] One day in the year commemorates the deliverance of Israel from Egypt, though the acutal time for all the plagues may have been more than a year. One day with the Lord is as a thousand years and a thousand years as one day. Setting one 24-hour day aside to commemorate the completion of God's creation, has nothing to do with the length of time it took.

I have tried to answer objections to the day-era concept before bringing plant and animal life on the scene, in order to avoid any confusion that it necessitates belief in a theory of Evolution (which has suc-

cessive forms of all plants and animals coming into being by the natural selection of mutations). for it certainly does not!

How hot the original earth was we do not know, nor whether it is now cooling or heating up from radioactive energy in its interior. If it were originally quite hot the water would be in dense clouds of steam. As it cooled, water would condense into lakes and seas. "And God divided the waters which were under the firmament from the waters which were above the firmament."

The contraction of the earth and the buckling of its crust cannot account for the size of our continental masses and the height of our mountain ranges, nor can it explain how they are maintained when one would expect them to be eroded level. Heat convection currents in the mantel of the earth could explain our mountains. The mantel is composed of molten, viscous rock. The hotter interior expands it and causes it to flow toward the surface in periodic, rapid overturns. These could thrust the overlying crust up into mountain ranges. Our deep seas could be dug as the cooled rock flows back into the interior. And God said, "Let the waters under the heaven be gathered together unto one place, and let the dry land appear."

Now that land masses have been formed, the preparation of soil can begin. The water vapor and rains and ground water can chemically alter the rocks, carry them down and deposit them in gental slopes and valleys, ready for tiny roots of plants. And God said, "Let the earth bring forth grass." This grass is the first grass that ever grew. Gen. 2:5 says this is the record of how God created and made every plant of the field (fossil or otherwise), and every herb of the field before it grew. This event would probably correspond with the Cambrian strata of our earth. A person standing on an ancient Cambrian sea-shore would find it very similar to a modern sea-shore. It would abound with all forms of invertebrate animal life and the plants; algae, etc., that are in balance with them. The first appearance of life was rich and varied. And God said, "Let the waters bring forth abundantly". Why God waited until the fourth day of creation to designate the stars for signs and for seasons, I don't know. That some stars exist before our Solar system was formed we are reasonably sure.

There are local discontinuities in the fossil record and longrange cycles and trends, yet it tells but one unbroken account of life on this planet. There is no universal, simultaneous break in its continuity such as a recreation would be. Fern forests, dinosaurs and birds with teeth, blend imperceptibly with modern forms of life. As the fossil record is traced upward, vertebrate life makes its appearance, and the ancient seas begin to swarm with fish. Then mammals appear in terrestrial deposits, and finally man himself appears. And God said, "Let us make man in our image". In many ways man is similar to the animals and plants. We would expect God to use the same building blocks in us as in them to perform the same function.[2] Our similarity with them is certainly evidence of a common origin. For in God we both live and move and have our being. For His pleasure we are and were created.

This account is not intended to be an answer for everything, but a reasonable interpretation that fits the facts as I see them. Genesis, chapter one, is here considered to cover several billion years. Successive creative acts are separated by indeterminate periods of time, resulting in a sequence of events which seems natural to the scientist, but is the handiwork of our Creator. Widely held alternative theories have been found to be unscriptural and inconsistent with the facts. This period of time may seem long to us, but I am sure that it is not long to God. The Husbandman of the earth hath long patience over the precious fruit of the earth.

I have two purposes in presenting this paper:

1. To show how beautifully Genesis can fit what I consider good science.
2. To show how untenable the reconstruction theory is.

I do not attempt to prove the goodness of the science I use, but I give references to my source material, for those interested in this phase of it.

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Book Reviews

Another attempt to bring us back to Ussher's chonology and flood geology is Dudley Joseph Whitney's new book, "Face of the Deep." It is dedicated to "George McCready Price, who early in this century, showed that sedimentary rocks and the fossils which they contain were laid down by flood action and not by common processes through long ages; also that there is no time order to the fossils."

Here is a discussion of the nature and age of the earth, geologic history related to the continental terrace and the deluge, and the problem of the origin of the earth. Anyone reading this book will need to study some of the articles in the Journal of the A. S. A., such as "Methods of dating the earth and the universe" Vol. III, No. 1, before concluding whether he should go back to a belief in a very recent creation and flood geology.

The volume of 102 pages is available from the Vantage Press, 120 West 31st Street, New York 1, or may be borrowed from the A. S. A. library.

CHRISTIAN FAITH AND NATURAL SCIENCE by Karl Heim, New York, Harper & Brothers, 1953

This book is not a popular treatise on the subject, but a rather heavy metaphysical treatment demanding real concentration by the reader. Many American scientists will find that it requires more knowledge of philosophy to follow Heim closely than is usually afforded in the curriculum of a science major in American Universities.

Professor Karl Heim, of Tubingen, is well acquainted with science, but his approach is almost entirely philosophical. He does not explicitly define "Christian faith" or "natural science". His theological presuppositions are fairly clear, however, since his approach is that of existential philosophy. His attitude toward the New Testament is interesting. He refers to it as a "profoundly significant document" (p.119). Later he says, "If, then, we wish to assign the New Testament to its proper place in the line of development which leads from the primitive phase of human thought to the present day, we must say that it is already beyond the initial stage of human thinking" (p.120).

Heim's book is divided into three parts: I Introduction; II The Ego and the World; III God, the Ego, and the World. His introduction is a masterpiece of analysis of the contemporary tension between secularism and theism. We can applaud Heim when he says that our age is not characterized by a questioning atheism, but by a *serene secularism*. "We are living in a time when in all civilized countries the tide of secularism is slowly but continually rising. . . . Amid this rising flood of secularism there floats the ark of the church. The church is like a ship on whose deck festivities are still kept up and glorious music is heard, while deep below the water-line a leak has been sprung and masses of water are pouring in, so that the vessel is settling hourly lower though the pumps are manned day and night" (p. 24).

Heim considers the following questions raised by the secularist:

(1) Is it not illusory to think that the power which moves the galaxies cares about us?
(2) Are not consciousness of guilt and inward peace mere conditions of the brain?
(3) Is any philosophy other than secularism possible for the modern scientist?
(4) In view of the modern world-picture, is it still possible to believe in a God who works miracles and grants prayers?

Heim then asks, "How are we to face these questions?' His answer: "We do not start out from the conclusions of natural science, but begin by constructing a philosophical basis" (p. 33).

Heim points out that "we need a firm basis which will render us independent of momentary currents of scientific opinion . . . some position which is entirely beyond the range of the scientific method . . . a position which does not have to be defended against scientific objections" (p. 32).

The author proceeds to build his philosophical structure on two realities: (1) the Ego, and (2) God. The Ego must be presupposed if there is to be any science in the first place. The existence of God may be denied, but the question whether God exists or not is not amenable to the scientific method (p. 33). For Heim, however, it seems that if the Ego is admitted, then inevitably God must be admitted also.

The purpose and plan of Heim's book is stated on page 34: "to demonstrate . . . that not only the ego, but also the reality of the personal God in fact belong to a dimension which is different from those of everything which is accessible to scientific investigation."

In parts II and III Heim borrows freely from the existentialists Heidegger and Jaspers. He dwells extensively on the meaning of the "I" and the "Thou" as discussed by various existentialists. He defines "non-obective space" as that in which the "I" and the 'Thou' encounter one another. From this he traces the history of the preparation for discovery of this "second space", which must be distinguished from the "objective space" of science as revealed by telescope and microscope.

The crux of Heim's book has to do with the concepts of various spaces. He argues that philosophy has at last come to realize the existence of a "supra-polar space, which has wrought a revolution in modern

thought". This supra-polar space, Heim tells us, is the "space in which God is present for us" (p. 163).

The contemporary tension between natural sciences and philosophy is due to the fact that the concept of space accepted in physics conflicts with the theory of spae at the foundation of the Kantian system. Kant says that space is from "intuition *a priori*", whereas modern physics says that the concept is from "outward experiences". Heim inquires, "how can a new space manifest itself? There is only one possible way. In the second space something is possible which, in the first space, was contradictory. There are spaces which, although we cannot conceive them intuitively, still possess structures which can be adequately expressed in algebraic terms."

The reviewer was particularly impressed with Heim's treatment of "Relativism and Positivism". He asserts that so long as we are confined to polar (objective) space, we must accept either positivism (sovereign decisions of human legislators), or relativism (all values are the product of historical development) (p. 186). The escape from this dilemma is possible only by granting a supra-polar space. A synthesis of relativism and positivism is declared to be realized in "Christ the preeminent'.

In the two final chapters Heim comes to grips with this question: "Is supra-polar space a fact or an illusion?" If it is a fact, then there are four inescapable consequences:

(1) There is a personal God
(2) Each of us receives his personal existence directly from God
(3) There is a sanction for our actions
(4) There must be a plan derived from a Universal Mind

If, on the other hand, it is an illusion, then there are four contrary conclusions:

(1) There is no personal God; only impersonal fate
(2) Personal existence is a meaningless coincidence
(3) There is no sanction for our activity
(4) The whole process of nature is a meaningless interplay of forces.

Secularism, Heim asserts, to be consistent, must necessarily attack the belief in suprapolar space as being purely illusory.

Heim never quite gets to a discussion of revelation and redemption in Christ as a means of arriving at certainty about God. The revelation of God in Christ is not as clearly delineated as an evangelical Christian would desire. He does approach this, however, in the last chapter, when he inquires ". . . how the space of eternity . . . can become certainty for us, if it can be reached neither by . . . observation . . . or inference from . . . facts. . . . There is only one answer . . . there must first have taken place in the depths of our existence a transformation which is not within our control" p. 241). For Heim, the "encounter" with God brings this transformation.

The reviewer has great admiration for Heim's masterful handling of the problem at hand. He has brought it into sharp focus. A careful reading of the book will be stimulating and rewarding. It is seriously to be questioned, however, if the author has succeeded in his purpose. Will a "serene secularist", after reading this book, agree that there is a reality beyond the pale of scientific investigation? Only time will tell. We can agree with Heim that knowledge of God comes only by a "second birth" p. 248).

Reviewed by
O. Carroll Karkalits

CONVERSATION WITH THE EARTH by Hans Cloos. Translated from the German by E. B. Garside. A. A. Knopf 1953

The head of the Geology Department at Bonn, a real lover of nature, takes the reader with him in his investigations of distant lands. It is pleasant to follow, with hammer and knapsack, through the Black Forest, the veldt of the Transvaal, and Bright Angel Trail of the Grand Canyon.

The book is more than a travelogue, however, for successful geological work is reported. For instance he mentions Johannes Wanner, who "showed the Hollanders where to find petroleum on their so richly endowed islands of Sumatra, Borneo, and Celebes. He grew wealthy doing this, but, being an altruist, he used his money for the promotion of pure science. He explored, sought, and found, and brought back with him a small shipload of fossils. Now, this heart being already a little wearied, he divides his time between the beautiful and the utilitarian branches of his profession. Besides splendid sculptures of the fat buds and blooming cups of sea lilies from distant Timor, he produces exhaustive maps and tables; acts as consultant on the conditions of soil and water, of stone and ore—the kind of information a practical man must have if he intends to deal profitably with the earth." p. 348

Another successful feat, this one by the author himself, was the interpretation of the Rhine Valley. The Rhine River flows through a trough (graben) formed between two parallel faults. Was the land on either side of the trough pulled away, allowing this slice to sink, or were the two sides pushed together, forcing them to rise higher than the trough? Of course the fault lines at the surface were covered with talus and vegetation which locked their secret. But when, fortunately, a railroad tunnel was bored through the mountain, it cut through the fault plane. Cloos could see, from the angle of the fault and the lines formed by one side sliding upon the other, that the first theory

was correct. The sides of the valley had been pulled apart, allowing a V-shaped strip of land to sink and so form a trough.

These two examples are types of the service which geology has rendered. Local problems have been solved, many of which are economic in nature. Just as one should expect, the author frankly mentions formations which are yet to be interpreted, for instance gneiss near the gorge of the Hollental. (p. 317)

But it may surprise the reader to learn that even some basic principles of earth science are not settled. The author gives lip service to popular geology, based upon evolution, but does not add to the proof, and on the other hand, states his misgivings. Spending 56 hours at the Grand Canyon, "All this while I was asking questions of myself and probing, but getting no answers. Constantly I was being astonished and overwhelmed." p. 235. We should expect this trained geologist, at this deepest rift through the sedimentary rocks, to say how clearly it provided the doctrine of uniformity, and orderly succession of periods. But he admits, "An attempt to compare the strata of the Colorado Valley with the corresponding ones in California was unsuccessful. The strata of the Coastal Ranges are much thicker, much more marine than continental, and much more complete. There are hardly any gaps. They have been intensely folded, in addition, and altered by the folding process." p.239 Again, "I have often wondered elsewhere whether the huge masses of rock missing from valleys have simply been carried away by surface agencies, or whether stronger subterranean forces were needed to excavate the enormous hollows. These parts of the landscape may have subsided, after which surface agencies merely completed what has been prepared by underground forces." p. 240. If a river does not make its valley but only finds and finishes it, we can not determine time by its erosion. This suggestion of the author does not support uniformitarianism but rather the cataclysmic doctrine of Cuvier.

A gem of reasoning is the following paragraph based upon ice. "How fortunate that ice still exists for comparison! Where would we be if by chance there were no more ice on the continents or at the poles; perhaps no glaciers, nor even the tiniest ice pocket in the remotest corner of the highest or most northern mountain ranges? That is, if the earth's climate today were such that no water would ever be found anywhere in the solid state? Could we then visualize the geological effects of ice? Would any human brain have the intricate notion that water can crystallize and form large cohesive masses which flow through valleys, overrun plains, climb over hills and mountains, and permanently alter the face of the earth? And if someone had thought of it, would such a humorous hypothesis ever have been taken seriously? And finally, are we not today in the same serious situation with respect to other terrestrial phenomena, a situation in which, accidentally, no events take place now which can be compared to the geological events of the past? May not this be the reason for the difficulty in interpreting many geological events, and for the controversies these interpretations raise?" pp. 53, 54

While Cloos does not mention religion frequently, he does not hesitate to say that nature is a revelation of God. He looks upon creation as a continuing process, however, to which this reviewer does not agree.

The book is informative and interesting, and should be read thoughtfully.

William T. Tinkle Ph. D.
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Taylor University

BIOLOGY

by

Irving W. Knobloch, Ph.D.

On the Recapitulation Theory in Biology . . .

Recapitulation may be regarded as fundamentally the result of the necessary passage from simplicity to complexity, from low to high organization, which is entailed by the metazoal sexual system of reproduction, with its single egg cell. The retention of visible organs or structures from lower ontogenies in a given ontogeny is only a special case of this general rule and probably depends on the presence in them of essential formative stimuli.—Joseph Needham, 1930

1. Introduction.

After some fifty years of advances in Biology, the basis of the Theory of Recapitulation, as formulated by Haeckel, can be shown to be unsound. Traditionally, this theory, or the Biogenetic Law, as it is sometimes called, stated that the individual in its life history passes from zygote to adult through a sequence of stages which correspond to the adult forms of its ancestors. Haeckel summed up this doctrine in the familiar phrases, "ontogeny recapitulates phylogeny". These sayings have adorned Biology texts for the better part of the first half of this century, showing how the notions of ancestry, heredity, and development were united in a three-fold manner: the ancestors created, heredity transmitted, and development repeated, the adult characteristics of past organisms.

2. History

The origins of this idea can be traced as far back as Aristotle, whose "scale of nature" captured the imaginations of biologists for centuries to come. He did not express recapitulation in its recent definitive form, to be sure, but the essence of it can be found in his writings. This was an ideal representative of the

animal kingdom, arranging the adult forms of many species in a successive order with man as the pinnacle, and, as such, can be found in the writings of such men as William Harvey, John Hunter, and Charles Bonnet, as far along as the eighteenth century.

Gradually, though, the idea of comparing this animal series with the stages of individual growth became a natural one, and by it there were revealed similarities between the two successions. This was called the "law of parallelism" and was advocated by such continental figures as Serres, Kielmeyer, and Oken. It was widely prevalent until the time of Cuvier, and was looked upon favorably by Kant, Schelling, and Goethe, who were advocates of Natur-Philosophie, which had a strong following in Germany in the eighteenth and part of the nineteenth century. This school of thought had held that there is no gap between the inorganic and organic, so that nature is an organism which shows a graded series of forms from matter to man. Out of this thinking came the notion of an "ideal type", which does not exist in nature as a thing-in-itself, but which is mirrored, though often indistinctly, in the life of every organism. As such, this conception of the animal kingdom, so different from the modern Linnean approach, was to be a significant influence on the writings of Haeckel.

The first serious objection to this manner of thinking came from von Baer, who established the "principle of deviation" (1828) in place of the Meckel-Serres law of parallelism (1811-1834). On the basis of careful observations, he proposed the generalization that the similarity of two embryos of both higher and lower animals is dependent on the closeness of their kinship, the embryos of both higher and lower animals sharing a closer mutual resemblance than the mature forms.

Soon afterward, Fritz Muller became convinced, when working out the life-story of the Crustaceans, that the development of an individual is a historical document, with new stages added at the end. And so when Haeckel arrived on the scene (1866), the essential components of the idea were already in use, and he had but to revise and modify them in forming his famous dictum. According to him, the ancestral history is the actual cause of an individual's characteristics of development, so that phylogeny becomes the mechanical cause of ontogeny. Thus Haeckel attempted to combine the theory of parallelism, which is based on the Aristotelian idea of a scale of beings, and von Baer's theory of divergence, which says that the general characters of a large group of animals appears earlier in development than do the more specific. Similarities of structure he attributed to the actions of a common ancestry, and dissimilarities were said to be due to different lines of genealogical descent. And he explained the failure to discover adults corresponding to distinct embroyological stages as the extinction of ancestral species through natural selective agencies.

3. Critique of the Problem.

Now the evidence for Recapitulation, at first pause, is very great, for, indeed, there are many reminiscences of earlier types in embryonic development: There are many reminiscences of carlier types in embryonic development: There are distinct pharyngeal clefts in early stages of vertebrate growth that easily resemble the respiratory structures of fish; one can also find a tubular piscine heart, a cartilaginous endoskeleton, and a notochord all of which have their lower counterparts; the flat pleuro-nectid begins life with a shape just like any other fish, with its two eyed placed summetrically on either side of its head; and the limpet embryo first has a spiral gastropod shell which it later discards in favor of the adult conical variety. These are but a few easily found observations and they are incontrovertible.

In approaching this problem of why ancestral structures are repeated, it would seem that Zoologists sometimes tend to interpret phylogeny in terms of a morphologically graded series of contemporaneous types, with less emphasis placed on the palaeontological data. Haeckel made very little reference to such evidence as might be accumulated from the rocks, in a typical Platonic fashion, and he built up his phylogenies usually on ontogenetic data. Thus, his views differed from the Aristotelian parallelism largely by an extrapolation in time to make them conformable to the Darwinian point of view. The variations he recognized gave him trouble, to be sure, and these he called caenogenetic, if they could not be explained, as though they were vitiations of the ancestral record.

On this view, one would almost suspect the embryo of being disrespectful of its distinct ancestors, and had taken on the habit of playing games with the observer, if one were to fit the discrepancies in the record into a too strict Haecklian formulation. Thus there has appeared a rather complex vocabulary which is designed to explain the behavior of ontogenies when compared with the corresponding phylogenies, including "heterochrony", or the reversal of stages in evolution, "tachygenesis", or the shortening of parts of the life-history, and "lipogenesis", the dropping out of stages. But these are conceptual phenomena through and through, and, are arbitrary applications of an idealistic phylogeny upon biological units which operate in a space-time manifold. It cannot be established that an organism "drops out", or "shortens", or 'reverses" certain sequence in its life-history, but rather, it proceeds from start to finish in the shortest and most convenient manner.

4. Possible Explanation.

But these emphases on the inadequacies of the Recapitulation Theory do not explain it. Indeed, the most fundamental question is why there is a repetition at all.

With the advent of the axial-gradients by Child in 1915, and the organizer theory of Hans Speman in 1928, there have come renewed insights into the interdependencies of the parts of living organisms in space and time. Certain embryonic structures, as the dorsal lip of the blastopore, have the ability to induce differentiation in surrounding tissue. The pronephros must be present to insure the appearance of the mesonephros and metanephros; and the notochord functions in laying down the vertebral column. And so many of the so-called embryological vestiges may have vital roles to fulfill in individual development. In many other ways the appearances of recapitulation could result from the conservatism in the methods of organ function and formation.

It will be recalled that Haeckel maintained that the ancestral adult stages were pushed back in the individual ontogeny. But he could not realize that this is practically impossible to explain genetically, since gene actions are manifested throughout ontogeny. A simple explanation for what he thought were the appearances of ancestral adult stages would be that the changes are not easily recognized in early periods, so that the tendency of new characters to appear in later development would be a statistical consequence of increasing complexity.

Then, too, the principle of the multiple effects of simple genes may be applied to explain the appearance of vestigal organs. There may be one gene which pleiotropically causes the primordium of an ancestral organ to be laid down, in addition to having other effects. Possibly the most interesting insight into the genetic aspects of the problem has come from the work of D'Arcy Thompson and Huxley who point out how many ontogenetic phenomena may be explained in terms of genes controlling growth-rates.

As an example of how the view-point concerning Recapitulation has been shifting since the turn of the century, is the following discusison of this theory (Shumway 1932:98):

> A consideratiaon of these biological developments, utterly foreign to the biological background of the early Haeckleians, taken with the many observational departures from the embryological sequences demanded by the theory of recapitulation, as well as the logical difficulties arising from an examination of the theory itself, seems to demand that the hypothesis be abandoned. Those of us who were reared in the phylogenetic tradition may see it go with a sigh of regret. Those of us charged with the responsibility of expounding the law of evolution to our classes will miss a familiar maxim, early learned, and a convenient skeleton on which to hang the discrete data of embryology. But there can be no excuse for continuing to impress plastic minds by means of discredited generalizations. Let us rather return to the laws of von Baer and explain the resemblances which these describe in terms of processes rather than of precedents. The resemblances may indicate close evolutionary relationships. Or they may result from convergent evolution. Only the methods of comparative anatomy, itself deductive, or palaeontology can indicate which. It is the function of the embryo to become an adult without looking backward on ancestral history. It is the business of the embryologist to describe the phenomena which he observes in terms of individual development without undue attention to what can be interpreted at most as reminiscences of evolution.

Recapitulation, thus, has turned out to be something quite unlike what it was first thought to be. It is not the mystical expression of some creative force in nature as the Nature-Philosophers lead by Kielmeyer, had thought; nor the mechanical pushing back of characters, as Weismann would have it; neither is it a simple expression of heredity, as Haeckel has obscurely maintained. The phenomena of recapitulation cannot be deduced from some simple general law, but rather they must be viewed as occurring in an organism developing in the most efficient manner possible, each stage of which is placed with careful reference to future development, as an individual expression of relative growth, and the fitting in of genetic actions into the life of the individual.

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PHILOSOPHY

by

Robert D. Knudsen, Th.M.

A short time ago I requested Dr. Clark of Butler University to write for this column on some recent development in the field of ethics. He has kindly responded with a note on science and morality in the thought of John Dewey.

By the way, in responding Dr. Clark said he would welcome further discussion on his own philosophy of science. Are there any takers?

A Note on Science and Morality

In his *Quest for Certainty* (p. 18; cf. *Experience and Nature,* p. 394) John Dewey suggests that the true problem of philosophy concerns the relation between science and morality. He may be right in identifying the problem, while at the same time his account of the relation may be untenable.

Running through a considerable portion of Dewey's writings is the theme that morality is or should be made continuous with science. Standards of conduct, he says (*Quest for Certainty* pp. 273 ff.), are to be had very largely from the findings of the natural sciences. Education and morals are to advance along the same road that the chemical industry has travelled (Reconstruction, p. 73). The success of science in limited fields is the promise of effecting integration in the wider field of collective human experience (*Quest,* p. 255). Do we put his thought too crudely if we say that moral values are to be formulated by the same processes by which we formulate a law of physics?

As Dewey works out this basic theme, he spends time stressing the relation of means to ends. Mortality usually involves a struggle toward an end, and if the struggle is to be successful the means and the conditions must be taken into consideration. Inasmuch, however, as supernaturalism, which Dewey constantly berates, does not deny the relation of means to ends, Dewey's choler must indicate that his meaning passes beyond the simplest sense of many of his sentences. In fact, it is a characteristic of Dewey's style to begin with a statement so trivial or tautologous that no one can deny it and then to add subtle shifts of meaning until the conclusion is far removed from the premise. In this case the means which Dewey stresses are not merely means to produce a good result, but they are means which make the result good. For example, suppose that eating roast turkey is an enjoyment. If by chance I should happen in at a friend's home in time for dinner and found they had roast turkey instead of sweet breads which I do not care for, the eating would be an enjoyment, but it would not be a value. Yet, for my friend's wife, who carefully prepared the turkey and its accessories, the eating would be both an enjoyment and a value. Values, says Dewey (*Quest* p. 259), are enjoyments which are the consequences of intelligent action. If the enjoyment occurs just somehow, it is not a value.

For Dewey this way of putting the matter is essential to his construction; and to this extent any weakening of the point undermines his general position. As a preliminary criticism two interrelated remarks may be made. First, one may obstinately enjoy enjoyments however they may come. Dewey does not seem to have given any reason for the restriction he has laid upon value. He seems to have made an unsupported assertion. Indeed one may hold it plausible that the greatest enjoyments, or at least several important enjoyments, appear without intelligent calculation of results. They come unexpectedly. This leads to the second remark. Could it not be that Dewey's calculated enjoyments are less enjoyable than the unexpected enjoyments? Suppose one were to construct an elaborate method of obtaining a small amount of pleasure. This would satisfy Dewey's conditions, but conceivably it would not be worth the trouble. May not one conclude therefore that the greater the amount of work required, the less valuable the value? It is true no doubt that more enjoyment or more frequent enjoyment will result from intelligent action than from mere accident, and to this extent Dewey speaks the truth; but it is far from self-evident that the trouble of producing the result is the cause of its being good.

There is another and much more fundamental difficulty with Dewey's account of value. Let us grant that attention to scientific procedures is the surest method of guaranteeing desirable results. Health, comfort, and other interests can best be assured by a study of their causes and conditions. But health and comfort are not the only ends men choose to aim at. Some men make money their goal even to the detriment of their health. Others endanger their lives in order to win an auto race. There are those also who renounce comfort to build a political machine, engineer a revolution, and rule as a dictator. Science can instruct each of these as to the most effective means; but how does a study of means, causes, and conditions determine the choice of one end rather than another? Is it not rather the previously chosen end that determines the nature of the scientific investigation? Science is a servant; it does not control.

Repeatedly pragmatism or instrumentalism has been criticized as being entirely subjective. Each man chooses what he likes, and his theory is true if it works to get him his desired end. But it is meaningless, so

the criticism goes, to assert that one end is better than another; or at least it is meaningless to assert that all men ought to choose the same ends.

Dewey is incensed at this charge of subjectivism. In his *Reconstruction of Philosophy* (pp. 146, 157) he repudiates the implication that instrumentalism makes thinking a means of attaining some private advantage, and he asserts that a personal end is repulsive. Now, it may be true that an instrumental view of science does not necessitate subjectivism in morals; but if science and morals are continuous instrumentalism cannot exclude such a subjectivism. An instrumental science can be the means of achieving a private personal, selfish aim. But such an aim Dewey calls repulsive. However, in the course of history many men have not agreed that personal or even selfish ends are repulsive. Dewey here and there tries to dispose of these opponents by calling them irresponsible and morally deficient. All honest men, he says in his *Ethics* (revised ed. pp. 265, 292), agree that murder and wanton cruelty do not have beneficial consequence. Contrary to his usual emphasis on change and diversity, Dewey here insists on a large moral uniformity among men, at least among 'honest" men. But the vituperation he bestows on his opponents shows that not all men are 'honest" (i.e. agree with him), and it also shows that he has failed to convince them by argument. Surely a theory that professes to establish values by a scientific procedure ought to be able to produce arguments as persuasive as those of the natural sciences. Possibly moral science is not yet so far advanced. In his *Problems of Men* (pp. 178, 179) Dewey expresses the hope that a scientific study of the causes of desire will produce a technique by which the more enlightened portion of the community can make the dishonest men have the right desires. Since the time Dewey wrote this, the Chinese communists have made progress with their brain-washing technique.

And here lies the basic problem: which men are honest and which desires are right? There is no such moral uniformity among men as Dewey alleges. Although vague and general terms, like the good and the desirable, may be agreed upon, the concrete desires of men are heterogeneous. The items some men call good, other call evil; what some men call repulsive, other men eagerly embrace. And were we able perfectly to produce and control the desires of our victims, this scientific instrumentalism would afford no basis for choosing one end rather than another. The conclusion therefore seems to be that scientific ethics, in spite of the denials of its exponents, does not escape subjectivism and moral anarchy.

Gordon H. Clark
Butler University.

Letters

365, Kings Road,
North Point, Hong Kong.

Dear Friends,

It is good to see that the desire to be missionaries is finding its place in the thought of young doctors, who have come out to Hong Kong in the Army. One of these took care of my clinics, and thus gave me a short holiday in July, which was most acceptable. An old missionary friend from Honan, came and took morning devotions for the Staff and patients, and the young doctor was interested to see how it was done. May the missionary seed sown in his heart bear fruit, when his time in the Army is finished.

A few miles from Hong Kong there is another island, on which is a high mountain, and being on the top was like having a week in Scotland, and I enjoyed it thoroughly. My only regret was that my dear wife was not there to spend the time with me and with our friends Archdeacon and Mrs. Donnithorne. Duties and responsibilities at home in England necessitated her return in Many, and so after some enjoyable months together, we have had to part again for a time.

After my return from the mountain, the Rev. Eric Hague asked me to see a man, Cheo-Tzu-Long, who had had both his feet blown off. He was a beggar walking on his knees, and Mr. Hague wanted me to fix him up with legs. Money, perseverance and the surgical fashioning of new stumps were all involved. After eight months the task seemed completed, and to our delight Tzu-Long walked about on his artificial limbs like a new man. How to find him a job had caused much thought and correspondence. By last Friday we seemed near the end of our task, but when a policeman met the transformed Tzu-Long on the street, he recognized him as being a lapsed deportee, transported five years previously for begging! How the policeman remembered him is more than I can fathom. His trial took place two days ago, and I am glad to report that a letter from me, and the presence of Mr. Hague procured his release. The judge was most considerate. How one could muse on the price of a soul. If it costs so much in this life, no wonder that Heaven had to be robbed of its greatest treasure to save you and me. Tzu-Long has learned this for he has given his heart to the Lord.

Mrs. Yung has been brought to the clinic by her daughter Nancy. I found that Nancy was being influenced by the Roman Catholics. She and Gordon her fiance, both speak English, and we have had many talks together. The question of their decision for Christ has been settled, and now they are realizing their need for Bible study and prayer. When Gordon

became a Christian, he had first to put the question to his grandmother. "She is a pagan," he said, "and I approached her with trembling as she is a masterful old lady." To the surprise of us all she gave her consent to my being a Christian, but she herself remained unchanged. Then my small brother, her youngest grandchild, became ill, so ill that he was approaching death. She knew that none of her gods would avail, and for the first time she turned to the Jesus whom she knew I had accepted. She prayed then in the Name of Jesus, and the child improved, and continued to improve until he was well. This is the event that has really changed her and our home. Now she says that only prayer in the Name of Jesus avails, and her days and much of her night are given to prayer.

We think that the Victorian age had a monopoly of stern fathers controlling refractory daughters! By no means, for David Wang has just told me his story:— David has been staying with me in my flat, while he awaits his visa to U.S.A. His fiancee, Annie, has just left for the States and they have both set their hearts on full training for the Lord's sake, leading to full time service for Him. Her father had other and far more worldly ideas for his daughter, and he forbade the young people to see one another. He blamed David and Christianity for the wonderful change that had come over her. Then he found another change taking place in her, due to his prohibition. Her cheeks lost their roses and she began to wilt. Praise God, the Father relented, and allowed them to meet for half an hour a week. How I smiled when I heard it. Love found a way, and before she left, my telephone almost caught fire with the frequency and ardour of the messages that flew between David and Annie!! It will not be long now before he is on his way to the Moody Bible Institute, whilst Annie has already gone to Wellesley College. David tells me now that his younger brother has given his heart to Christ. "How often I have exhorted them," said David. But he wrote that his heart was set on going to Russia for further studies but now what a change! By chance he went into Wang-Ming-Tao's Church in Pekin, and there he settled the question and has come right out on the Lord's side. How very wonderful, for this is happening in Communist China, the extreme cost of missionary endeavor has not been in vain, and the Church established there is standing in the vortex of the storm. But still the "blood and tears" are being shed, for Wang-Ming-Tao, his family and 18 of his Church members were visited at 1 o'clock in the morning and carried off to prison by the secret police. A fitting hour for the Reds and those who love darkness.

My clinics go on here apace, and I would ask for your prayers for a plan to extend medical-evangelistic work into the New Territories right up to the Red border. Both the Church of England and the Lutheran World Service have such a plan in mind, and the latter have asked me to take charge of the clinics they plan to open. Recently, a patient, who had been to my clinic in KingsRoad, after exhausting all other possibilities for getting cured, was miraculously healed after one visit. As a result, many people in the village of Tailing were greatly influenced in the direction of Christianity, to the extent that one man donated a large room in his home as a chapel.

Following the above incident many people in Tailing threw away their idols, and looked to Jesus Christ for life and hope. Unfortunately, however, the faith of many of these people is still very immature, and the devil is constantly striving to win them back. In the light of the above, the time seems opportune for opening clinics in the New Territories, and yet if I attempt more than I am already doing, the medical work here would inevitably suffer. Do pray that I may be guided, and that some way may be found of helping the people in these distant villages. The Bamboo Curtain is becoming so porous, that even now patients are coming across from Red China for treatment in increasing numbers.

Our elder daughter, Elizabeth, has just become engaged to Mr. Philip Habershon, the eldest son of the Vicar of Holy Trinity, Tunbridge Wells. We do rejoice with them both in their joy, and pray that they may always be a strength and inspiration to each other.

My dear wife is in the throes of selling our house, and buying another and more suitable one. I do hope that this will not hinder us from seeing one another again this coming year.

And so farewell, and please pray for us,

Yours very sincerely,

D. VAUGHAN REES.

Textbook Contest Prize Winners Announced

GRAND RAPIDS, Mich. The Zondervan Publishing House has just announced the prize winners in its Christian Textbook Contest which closed September 30, 1955. The prize winners and their prizes were as follows:

Dr. R. Laird Harris—$1500.00, First Prize

Dr. C. B. Eavey—$750.00, Second Prize

Dr. Samuel A. Cartledge—$250.00, Third Prize

Dr. Harris, Chairman of the New Testament Department of Faith Theological Seminary, Elkins Park, Philadelphia, was awarded First Prize for his manuscript, *"The Inspiration and Canonicity of the Bible."* The first part of Dr. Harris's manuscript deals with the basis and history of the belief in the verbal inspiration of the Bible, with consideration of various objections to the historical Christian position. The

second part deals with the principles on which the books of the Old and New Testaments were chosen, and why these books and no others are believed to be inspired. Dr. Harris's book is scheduled for publication in late 1956. He is also the author of "An Introductory Hebrew Grammar" and has contributed numerous articles to various scholarly journals. Dr. Harris is a Fellow of the American Scientific Affiliation.

Dr. Eavey is the former head of the Education Department at Wheaton College, Wheaton, Illinois. His manuscript, "Christian Ethics—Principles and Practice" was awarded Second Prize of $750.00. Dr. Eavey is also the author of several Christian Education texts including: "Principles of Teaching for Christian Teachers," "The Art of Effective Teaching," "How to be an Effective Sunday School Teacher' and others.

Dr. Cartledge is a professor at Columbia Seminary, Decatur, Georgia. His manuscript, "A Basic Grammar of the Greek Testament' was named Third Prize-winner. He is also the author of "A Conservative Introduction to the New Testament."

AUTHOR INDEX

Author and analytical subject indexes for the complete set of "Journals" from March 1949 through December 1955. (C) refers to a regular column, (B) to a book review.

SUBJECT INDEX