presented by Rusch. We will handle for sale: *Astronomy and the Bible* by DeYoung and *Origin of Living Things* by Kautz. We will reprint: *Speak to the Earth, Scientific Studies in Special Creation* and *Design and Origins in Astronomy* by Mulfinger. We will print *Five Year Subject Index of CRSQ* and *Creationist Research 1964-1988* by Gish and *Origins: What Is at Stake* by Rusch. The Publications Committee is studying the feasibility of publishing a new series called Creation Classics, the first volume being *Darwin, Evolution and Creation* by Zimmerman. Other titles under consideration for publishing are: *The New Diluvialism* by Clark and *The Transformist Illusion* by Dewar.

The Board moved and passed the following recommendations of the Finance Committee:

1. The Society's fiscal year be changed to January 1 through December 31.
2. The Treasurer be authorized to purchase a computer and appropriate software at a cost not to exceed $2500 for accounting purposes. The computer is to be compatible with the computer of our accountant.
3. Withdrawal of invested funds require the signatures of two of three of the following 1) President 2) Treasurer 3) Financial Secretary and that the Secretary so certify to institutions holding the Society's invested funds.
4. For this year only the Treasurer shall serve also as Financial Secretary.
5. The Financial Secretary invest the Society's endowment funds in treasury bonds, treasury notes, treasury certificates and federally insured CD's. There should be a mix of these and also a mix of maturities with none to exceed five years. When making investments the Financial Secretary must confer with the Chairman of the Finance Committee and the President.
6. The Vice-President conduct a Christmas appeal for the Quarterly Endowment Fund.
7. The present dues structure be retained for the next year.
8. The Treasurer confer with the Society's accountant to develop the best possible financial system for the Society including a system of vouchers for the payment of bills.
9. The textbook fund be discontinued and the balance be transfered to the book sales fund.

The meeting adjourned at 1130 hours for lunch and reconvened at 1300 hours. The Board authorized the Secretary to write a letter to Dr. Ted Aufdemberge thanking him for help in setting up our meeting. It was moved and passed that Frair, Howe and Meyer be re-nominated for the 90/91-92/93 Board terms.

It was moved and passed that the following be reelected for 89/90: President, W. Frair; Vice President, G. Howe; Secretary, D. Kaufmann; Membership Secretary, G. Wolfrom; Financial Secretary, J. Meyer and Treasurer, J. Meyer. G. Howe was elected to Fellow of the Society by unanimous vote. The next board meeting will be 19-21, April 1990 at Ann Arbor, Michigan. Rodabaugh was appointed Chairman of the Friday evening educational program. It was decided that the Friday evening program remain the same for 1990 and the President appoint a committee to study the feasibility of a conference of scientific papers for the future. The Board authorized Frair, Williams, and Wolfrom to reprint back issues of the Quarterly as needed. It was moved and passed that the Financial Committee be empowered to set the salaries of the secretaries. The meeting was adjourned at 1440 hours.

David A. Kaufmann, Secretary

CRITICAL THOUGHTS AND CONJECTURES CONCERNING THE DOPPLER EFFECT AND THE CONCEPT OF AN EXPANDING UNIVERSE — PART II**

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Abstract

The main yardstick by which galactic distances are measured is based on the determination of the "absolute magnitude" of various star types, galaxies, and quasars. The "apparent magnitude," or actual brightness of the object is compared with its assumed "absolute magnitude" and a distance derived. Moreover, evolutionary astronomers rely on a parameter known, as the Hubble constant which is considered to relate the redshift of an object to its distance. This constant assumes that redshifts are mainly Doppler effects, and that its reciprocal, in conjunction with other constants (e.g. the cosmological constant L and the deceleration parameter q_0), gives the age of the universe. With the abandonment of the idea that redshifts are purely Doppler effects, the Hubble constant is discredited and attempts at deriving the age of the universe based on redshifts are shown to be of no consequence in the real world.

Introduction

In the last article I examined the basic supporting data for the expanding universe cosmology. In so doing I found that the interpretation that redshifts are Doppler effects results in absurd interpretations of non-conforming discoveries and data. It is my contention that the available scientific data call for a reinterpretation of the nature of the redshifts found in galactic spectra. To this end various other mechanisms which produce redshifts were proposed. The anomalous data which were examined have not gone unnoticed by the scientific community and have caused a debate over the nature of the redshifts. However, the

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vast majority of astronomers and astrophysicists still hold that they are Doppler effects. Yet many new findings clearly show that these redshifts cannot be completely Doppler in nature (if at all), leaving us with the realization that galactic redshifts cannot support the expanding universe cosmologies. The purpose of Parts II and III is to demonstrate the futility of trying to forge distance measuring methods for intergalactic space. In so doing I shall examine a fundamental constant of astronomy, the Hubble constant and propose that this "constant" probably has no meaning in the real world.

The Traverse of Light Through Space

The sum of the angles of a triangle on a flat plane is 180°. However, if you lay the triangle on a non-flat surface, such as a sphere, you would find that the summation of the angles is not 180°. For example, let us suppose that we were to inscribe a triangle on the earths surface. Start at the North Pole and move down the globe to the equator, turn to the east (90°) and travel along the equator for one-fourth of the earth's circumference (90"). Then turn to the north (90°) and proceed back to the point of origin. In so doing, we have inscribed on the surface of the earth a triangle of 270°. Thus the simple laws of plane geometry break down when a curved surface is considered. Now space is not considered by most cosmologists to be flat. Rather, it is considered to be curved. Thus, our most basic concepts of plane geometry cannot be applied to the distances between stellar and galactic bodies. Consider these descriptions:

> Concepts like 'straight' and 'curved' lines can be defined only in terms of the paths followed by light. According to Einstein's general theory of relativity, the path of light, that is, the geometry of space, is affected by the presence of matter in it. The curvature is locally greater, for example, near a massive body than it is far from all objects. The general curvature of space depends on the average density of matter in the universe.
>
> It is unlikely that any of us can visualize curved space, but an analogy may make it less mysterious. Consider the curved surface of the earth, which has a finite *area*, but is unbounded, and upon which the geometry is not Euclidean . . . An important difference between the curved surface of the earth and the curved volume of space, however, is that the space curvature may be changing—in fact, *must* be changing—if the density of matter in space is changing (Abell, 1973, p. 420).
>
> . . . If we imagine constructions to be made with rigid rods *in the surface* . . . we should find that different laws hold for these from those resulting on the basis of Euclidean plane geometry. The surface is not a Euclidean continuum with respect to the rods, and we cannot define Cartesian co-ordinates *in the surface.* Gauss indicated the principles according to which we can treat the geometrical relationships in the surface, and thus pointed out the way to the method of Riemann of treating multi-dimensional, non-Euclidean *continua* . . . (Einstein, 1961, p. 86).
>
> But speculations on the structure of the universe also move in quite another direction. The development of non-Euclidean geometry led to the recognition of the fact that we can cast doubt on the *infiniteness* of our space without coming into conflict with the laws of thought or with experience . . .
>
> In the first place, we imagine an existence in two-dimensional space. Flat beings with flat implements . . . are free to move in a *plane.* For them nothing exists outside of this plane . . . In contrast to ours, the universe of these beings is two-dimensional; but like ours, it extends to infinity . . .
>
> Let us consider now a second two-dimensional existence, but this time on a spherical surface instead of on a plane . . . The great charm resulting from this consideration lies in the recognition of the fact that *the universe of these beings is finite and yet has no limits* . . .
>
> . . . (if they measure on a very small part) . . . they will no longer be able to demonstrate that they are on a spherical 'world' and not on a Euclidean plane . . .
>
> Thus if the spherical-surface beings are living on a planet of which the solar system occupies only a negligibly small part of the spherical universe, they have no means of determining whether they are living in a finite or in an infinite universe, because the 'piece of universe' to which they have access is in both cases practically plane, or Euclidean . . .
>
> To this two-dimensional sphere-universe there is a three dimensional analogy, namely, the three-dimensional spherical space which was discovered by Riemann. Its points are likewise all equivalent . . .
>
> It follows from what has been said, that closed spaces without limits are conceivable . . . As a result of this discussion, a most interesting question arises for astronomers and physicists, and that is whether the universe in which we live is infinite, or whether it is finite in the manner of the spherical universe . . . (Einstein, 1961, pp. 108-12).

Since space is considered to be curved, and since there are innumerable curved paths in space, we would have to examine each curved path and define new laws of geometry for it before anything useful could be said about interstellar or intergalactic distances. This applies to any yardstick, even those dependent on light (e.g. redshift, absolute magnitude, etc.) since light would not necessarily travel in a straight line (or path). Since space has an infinite number of curved paths this would be impossible. In essence we are really ignorant about the nature of the space between our galaxy and another galaxy, and we have no idea what effect it may have on light waves passing through it. Some theorists have argued on this basis that light may in fact be able to cross the universe in as little as 15 years.*

The acceptance of Riemannian space allows us to reject Einstein's relativity and to keep all the

*Editor's Note—see *CRSQ* 21:18-22 for an article critical of this concept.

> ordinary ideas of time and all the ideas of Euclidean space out to a distance of a few light years. Astronomical space remains Euclidean for material bodies, but light is considered to travel in Riemannian space. In this way the time required for light to reach us from the most distant stars is only 15 years . . .
>
> In essence, therefore, the method of this paper leaves astronomical space unchanged but reduces the time required for light to travel from a star to the earth. (Moon and Spencer 1953, p. 635).

If light can travel faster than "c" the distances in space would be totally uncomputable. With intergalactic distances being basically unobtainable the Hubble constant would be thrown into doubt, along with the expanding universe evolutionary cosmologies which are presently held by the majority of the scientific community. Equally discredited would be attempts to date the universe since the Hubble constant is currently used to compute this age.

> . . . If it is assumed that the speeds of galaxies have not changed since . . . (the initial explosion) . . . a galaxy at a distance r, moving away with a radial velocity V, must have been receding from us for a time r/V. But r/V is simply the reciprocal of the Hubble constant; the maximum 'age' of the universe, depending upon the value of the Hubble constant would lie in the range 10 to 25 billion years. (Abell, 1973, p. 420).

Theoretical physicists have postulated the existence of particles (tachyon) which are considered to travel faster than "the speed of light." Light can definitely change its speed as it passes through different mediums. Light will travel slower than "c" when it passes through air, water, glass, or crystal. It is this effect which gives rise to the computation of "indicies of refraction" and causes light beams to split into a band of colors known as the spectrum. If light can travel slower than "c," is there any reason to believe that it cannot travel faster than "c" under certain circumstances? If evolutionary cosmologists feel no restraint in postulating the existence of particles which can travel faster than "c," is there any reason for creationist cosmologists to postulate that light quanta can do so also?

With the recognition that redshifts are not necessarily Doppler effects and the admission that light may be able to travel faster than "c" as it moves along the curved paths of intergalactic space, it becomes all the more obvious that any constant attempting to relate redshift to distance is unobtainable. Thus, the basic foundation of the Hubble constant is undermined.

The Hubble Constant and the Measurement of Intergalactic Distances

The Hubble constant is an adjustment factor which relates the recession speed of an intergalactic object (assuming that the redshifts are produced by the speed of these objects) with the distance between us and the object. Assuming that the universe did start in a monumental explosion and that the line shifts are entirely Doppler effects the following relationship was suggested:

$$V = Hr \tag{1}$$

Abell comments specifically on this equation:

> . . . the more distant a galaxy, the greater, in direct proportion, is its speed of recession, as determined by the shift of its spectral lines to the longer (or red) wavelengths. This relation is now known as the *law of redshifts*, or sometimes the *Hubble law*.
>
> . . . The actual distances to the galaxies whose velocities have been measured cannot be determined accurately, but the *relative* distances to clusters of known radial velocity (or redshift) are fairly well established . . . these clusters have radial velocities that are proportional to their distances. The velocity, V, of a cluster, in other words, is represented by the equation
>
> $$V = Hr$$
>
> where r is the distance to the cluster, and H is a constant of proportionality, called the *Hubble constant*, that specifies the rate of recession of galaxies or clusters of various distances. The Hubble constant is now believed to lie in the range 30 to 100 km/sec per million parsecs, a recent determination giving 50 km/sec per parsec. In other words, a cluster moves away from us at a speed of 50 km/sec for every million parsecs of its distance. (Abell, 1973, pp. 415-16)

Several assumptions are apparent. First, it is purely an assumption that the most distant galaxies display higher redshifts because they are moving faster. The mechanisms which were proposed in Part I will definitely produce redshift effects that are directly proportional to the distance that an object is located from us. Second, relative distances are nothing better than guesses. Consider the type of reasoning used in deducing relative distance. Object A is in front of object B and looks twice as bright as object B. Therefore, object B must be twice as far away as object A. This may sound logical, but it has a hidden assumption, that is, object A and B are identical in nature. As an example, suppose we view a lantern and a candle in the distance, approximately 1,000 feet from us, and suppose that the lantern is in front of the candle by 50 feet. By this type of reasoning we would deduce that the candle is five to six times as far as the lantern. But we would be wrong. Some may argue that by computing the rotation of a galaxy we might be able to determine its mass and create a mass/luminosity relationship. However in Part I, I examined this concept and found that it is not possible at this time to create any type of reliable mass/luminosity relationship for galaxies. We may assume that redshift is linearly related to distance and derive a constant (such as the Hubble constant), but there remains no way of proving that redshift displacement in spectra is linearly related to distance by some independent, objective means. Moreover, the work of Arp and Tiff shows conclusively that redshift is not dependent on distance, closer objects sometimes displaying larger redshifts than farther objects. Additionally, there are several other problems in determining galactic distances:

> . . . looking at things very far away is equivalent to looking far in the past, and if the observer can see a difference between how things were mov-

> now, he can maybe say something about openness or closure.
>
> The procedure is to set up a Hubble diagram, which compares the redshifts of galaxies with the light flux received from them at earth. The formula that relates the flux at earth to their intrinsic luminosity contains the deceleration parameter.
>
> This procedure works best if galaxies all have the same intrinsic luminosity. The fact is that they don't. Furthermore, galaxies are extended objects. Brightness varies across a galaxy's image, and the observer must be sure that his telescope aperture is adjusted to compare them.
>
> The observer can take the brightest galaxy in each cluster, or whole clusters, and hope that these will have the same intrinsic luminosity; but then evolutionary problems intervene.
>
> Galaxies evolve as units. Big galaxies tend to eat their satellite galaxies, and this changes their brightness as it goes on. Furthermore, stars evolve and change their brightness. As we look farther and farther away we look farther back in time to a period when perhaps the stars in the galaxies we see were all very young and therefore differently luminous from those in older galaxies. (Anon., 1976).

It is difficult to understand how Abell can contend that "the relative distances to clusters of known radial velocity (or redshift) are fairly well established."

The Parallax Method and the Measurement of Interstellar Distances

To more fully realize the role that intrinsic brightness plays in determining galactic distance, and the fallacy thereof, a brief synopsis of the history of this field of astronomy is given. Distances in space were first determined by using a simple triangulation technique in which the earth's orbital diameter served as the base of larger interstellar triangles. An expanded explanation is supplied by Degani (1963, pp. 77-78).

> The method used to find the distance to a star is known as triangulation . . .
>
> In finding distances to stars, the diameter of the earth's orbit about the sun . . . can be used as the line of position . . .
>
> The difficulty encountered in the case of stellar distances is that the line of position is small compared to the distances to be determined. The largest distance available to the astronomer is the diameter of the earth's orbit around the sun. Even this line of position, 186 million miles long, is only a minute fraction of the distance to one of the closer stars.
>
> To find the . . . (parallax of the star) . . . the following procedure is followed:
>
> The position of a star . . . close to the Solar System is observed with respect to faraway stars. When the earth is at point A, the direction in which we see the star . . . relative to the direction in which we see faraway stars is noted. Six months later, when the earth is at point B, the star . . . will be seen in a slightly different direction relative to the distant stars. This change in direction is the . . . (parallax angle) . . .
>
> The parallaxes of stars are extremely small angles. Even the nearest star, Alpha-Centauri, has a parallax of only .756 seconds of angle. This is a much smaller angle than the diameter of a dime would subtend at a distance of a mile. Other stars subtend angles of .1 second and less. The direct method of parallaxes has already determined the distances of 6000 stars. The distances to the vast majority of stars cannot be found by this method . . .
>
> In the process of finding the parallaxes for the various stars many corrections have to be applied to the readings taken by the observer . . .
>
> Some of these corrections are due to the motion of the star; others are due to the motion of the observer; still others are due to refraction of light by the earth's atmosphere.
>
> During the six months' interval between observations, the star itself may have moved slightly, relative to other stars. In the same interval, the whole Solar System, together with the observer, may have changed position. To obtain a reasonable estimate of the magnitude of these corrections, several sets of measurements extending over a period of several years are taken for each star under study.

However,

> The nearest stars are so far away that even a base line of 186 million miles is still embarrassingly short. After centuries of attempts by other astronomers, Bessel in 1838 finally measured the parallax of 61 Cygni, one of the nearest stars. The parallactic displacement he saw, back and forth over the sky every six months, was an angle of only .3 second—three tenths of a 60th of a 60th of a 360th of a full circle . . .
>
> Within months of Bessel's great measurement, Thomas Henderson in South Africa had found that Alpha Centauri was only 4.3 light-years away—it is now known to be the sun's nearest bright neighbor—and Friedrich Wilhelm Struve in Russia . . . had found the distance to Vega—now known to be 27 light-years. Beyond a distance of some 400 light-years-where the angle of parallax falls below 0.008 second—these geometric means of measurement are essentially useless. (Bergamini, 1969, p. 35)
>
> The vast majority of stars are beyond the reach of the parallax method; their distances have been determined by a rather indirect, although simple, method of comparing the apparent magnitude of a star with its absolute magnitude. (Degani, 1963, p. 80)

Only about 6,000 stars have had their distance determined through this method. Moreover, in determining stellar distances through the triangulation method there still remains the problem that plane geometry does not work in space. An excellent article has been written on the problems of using plane geometry in determining stellar distances by I. W. Roxburgh of the University of London (1977) which is well worth reading for anyone wishing to pursue the problem. It may be categorically stated that we do not know the summation of the angles of a triangle in free space. One commentator suggested that the differences of such small scales are equivalent to the errors caused by the earth's curvature when surveying small farms. This may be so, but even in property line and boundary determinations there are certain acceptable margins of error, and there exist certain methods by which error is balanced over all the angles and traverses of a survey. In space we have no such methods of correcting for "surveying errors," whether they be caused by inaccurate instruments, human error, or the curvature of space. Moreover, even a 2% error in distance measurement would have a profound effect on the concept of intrinsic brightness, which was the next yardstick forged by astronomers.

The Absolute Magnitude Method of Determining Distances and the Classification of Stars into Different Types

> The apparent magnitude of a star depends upon both its intrinsic brightness and its distance.
>
> To be able to compare intrinsic brightness of different stars, it is necessary to eliminate the dependence upon distance.
>
> The concept of Absolute Magnitude does just that. In this concept it is assumed that all the stars were removed from their real location to a new place, exactly 10 parsecs away from the terrestrial observer.
>
> Naturally, stars that are brought closer to the terrestrial observer will appear brighter, while stars that had to be 'pushed' to the 10 parsec line will now appear dimmer. **The new magnitude that will be assigned to the stars when they are 10 parsecs away is known as Absolute Magnitude** (Degani, 1963, pp. 80-81).

But how can one determine the intrinsic brightness of any star "type" with just a small handful of samples to work with? It is erroneous to try to work from the particular to the general. For example, we know that men are animals and that they have eyes. But cats are not men simply because they have eyes and are animals. There are many other distinguishing features which make men different from the other two-eyed animals which inhabit our planet. Likewise, we cannot make any generalizations about star types, especially their intrinsic brightness, from several specimens. Yet the intrinsic brightness of billions of stars, and their classification into "types," was based on the examination of only 6,000 stars.

The situation is even worse, for instance in determining star "types." It appears that many stars did not fit the ideal characteristics for the different "types" which were being catalogued. The solution to these "peculiar" stars was simply to disregard them.

> While it is not certain that a complete segregation into subgroups that are nearly homogeneous with respect to age, mass, and chemical composition is possible with these or similar methods, it has been found that intrinsic color indices $(B - V)_0$ and absolute visual magnitudes M_v of considerable accuracy can be determined . . .
>
> The role of exceptional stars with peculiar spectra has already been referred to, and the advantage in quantitative classification of dealing with samples from which such stars have been eliminated on the basis of visual inspection of spectrograms has been emphasized. (Stromgren, 1969, p. 183)
>
> Historically, the development of quantitative classification methods followed that of the methods based on inspection. The fact that the later methods had been found to be applicable to the great majority of stars in the galactic neighborhood suggested that quantitative classification based on evaluation of a few criteria should be feasible. In the actual development of the quantitative methods, use was made of samples of stars already classified by the inspection method. In particular, peculiar stars could be eliminated from the samples in question. In this way the obvious dangers connected with classification based on a very few criteria were very much reduced. (Stromgren, 1969, p. 123)

In disregarding "peculiar" stars certain "standard" stars which conformed to the theories were catalogued and are now used in determining distances.

> It is possible to define spectral indices as intensity ratios of definite wavelength bands in such a way that the measures are perfectly reproducible. Nevertheless, a set of *standard stars* for which the indices in the chosen system are known according to repeated measure . . . is of considerable value . . . (Stromgren, 1969, p. 124)

In effect, the theories were used to determine which data would be accepted or rejected and then the accepted data were used in support of the theory.

Once star "types" were determined (usually based on spectral characteristics) the next step was to determine the mass, radii, and luminosity of the "types." In doing so binary stars were looked to as an excellent means by which mass and luminosity could be determined. By using the parallax method the distance of the binary was determined, and by computing the motion of the stars in the binary utilizing their redshift, the mass of the stars was calculated. Once the mass and luminosity were known a mass-luminosity relationship could be established for the different star types.

However, it is admitted that the binary motions determined by examining the redshift of the member stars are subject to substantial errors.

> A reliable assignment of binary motion is particularily difficult for most velocity measures of A and B stars. The spectral lines are generally diffuse and few in number, so that plate velocities are subject to substantial errors. (Petrie, 1969, p. 74)

Naturally there does exist a difference between an impossible measurement and a measurement of low precision. But how can we consider the expanding universe model as proved when the supporting data have such low accuracies? Moreover, of all the binaries available for study, only 25 were considered to be suitable so far as distance and proper motion determinations are concerned.

> Direct information concerning the masses of individual stars is obtained from the study of the

orbital motions of the components of visual double-star systems which have measureable trigonometric parallaxes. Another source is the double-line spectroscopic binaries, which are also eclipsing variables . . .

In the present chapter are compiled the empirical data that are the best available at the present time for evaluating stellar masses, the mass-luminosity relation, and stellar radii . . .

At the present time, orbits have been determined for approximately 500 double stars . . .

A considerable number of the published orbits are not sufficiently well determined to allow the use of the orbital elements—i.e., the period, P, and the semi-major axis, a—in a mass determination. As a rule, orbits with periods exceeding 200 years belong in this category. Only a small fraction of the well-determined orbits can be used in investigations requiring stellar masses determined with fairly high accuracy because in the majority of cases the systems have too small parallaxes . . .

Since, in general, a trigonometric parallax cannot be determined with a probable error less than ±0.”005, it is seen that, for binary systems with parallaxes less than 0.”050, the masses have probable errors in excess of 30 per cent . . .

The limiting distance at which accurate masses can be obtained for systems with well-determined orbital elements severely limits the number of well-determined stellar masses. Approximately 20 systems have well-determined orbital elements, and parallaxes in excess of 0.”l, while a similar number have parallaxes between 0.”05 and 0.”1. Another 25 systems with well-determined orbital elements could give valuable data on stellar masses if lacking parallax and mass-ratio data were obtained . . .

In Table 1 are listed 64 visual binary systems within 25 parsecs of the sun for which orbital elements have been determined . . .

. . . It should be noted that, for nearly half the systems, parallaxes or improved parallaxes are needed, as well as mass ratios and improved magnitudes or magnitude differences between the components. Eighteen orbits have been designated poor, although five of these have short enough periods to allow a better orbit determination if they are observed sufficiently over the next decade. (Harris, Standard and Worley, 1969a, pp. 273-81).

For bright stars (Mb = 0) only 13 suitable binary systems were found for mass and luminosity determinations.

An extension of the mass-luminosity relation to the stars more luminous than Mb = 0, for which no data are available from visual binaries, can be based on the data obtained from those double-line spectroscopic binaries that are also eclipsing binaries. As in the case of the visual binaries, it is also desirable to limit the eclipsing binaries to be included in the discussion to those systems classified as “reliable” in the sense of providing reliable values of masses, radii, and colors of the two components . . . A tentative lists of “reliable” systems was assembled from compilations by Kopal and Popper. The list was critically reviewed by D. M. Popper and resulted in the 13 systems listed in Table 3 . . . (Harris, Strand and Worley 1969a, p. 286).

But, in fact, after all was said and done, most binary systems gave conflicting results. Thus, all but 13 were rejected as being unreliable.

The largest source of information regarding the radii of stars is derived from eclipsing binaries which are also double-lined spectroscopic binary systems . . . Unfortunately, as Struve has emphasized, ‘there are many “abnormal” double stars, and few, if any, that can be described as entirely “normal.”’ If, in addition, one restricts the discussion to “reliable” systems, it is found that only a small number of systems is available. It is to be noted that improvements in observational techniques are gradually extending this list of reliable systems. (Harris, Strand and Worley, 1969a, p. 288).

The classification of billions of stars into “types” was actually based on the data of only 13 binary star systems, all others being disregarded as out of the parallax method or as abnormal binary systems.

Once several basic star “types” were determined astronomers turned to clusters in an attempt to define and classify further star types and to check the types which had already been determined. However, there are only two clusters for which distances could be determined using the parallax method.

A quite independent test may be obtained by utilizing moving clusters in which the radial velocities of member stars may be calculated from proper motions and trigonometric parallaxes. This is a powerful and attractive method; it is greatly to be deplored that only the Taurus and the Ursa Major clusters can qualify as control objects, and even in these two cases the observational material needs to be improved. All other clusters are so remote that the errors in the trigonometric parallaxes produce intolerable uncertainties in the calculated radial velocities. (Petrie, 1969, pp. 69-70).

Relatively few data points (2) were used to classify the billions of other data points in the Universe. Moreover, there remain other problems in the use of clusters for this purpose.

Two points should be noticed in connection with a comparison of this kind: (1) in individual cases there may be doubt about the membership of a star in a cluster or association, and a large deviation may be spurious because the star in question is actually a non-member; (2) a considerable fraction of the stars are undoubtedly binary stars that have not been recognized as such because of observational limitations. (Stromgren, 1969, p. 182).

In fact, the problems are so complex that some astronomers have admitted that determinations of basic cluster characteristics is simply not possible:

The danger of attempting to determine the general characteristics of the motions of any

> group of stars which were originally selected because of their large proper motions has been pointed out on several occasions; even the radial velocities of such stars fail to yield a representative picture . . . The chief importance of the spectral surveys for red dwarfs is that, for the first time, they provide unbiased material upon which studies of group motion, dispersions, and velocity distribution may be based and from which more detailed studies of population differences among these stars will be possible. It is clear now that, since large orbital eccentricities are associated with large orbital inclinations, we cannot hope to obtain representative values of solar motion, velocity dispersions, etc., from discussions of the radial velocities of stars originally selected because of their large proper motions. (Vyssotsky, 1969, pp. 197, 201).

The immense amounts of uncertainty coupled with an insistence on deriving star "types" based on a handful (literally) of specimens has resulted in theories that do not work and it is readily admitted that many stars in the so-called "types" simply do not conform to the general characteristics ascribed to them (Keenan, 1969):

> . . . Nevertheless, there is evidence that differences exist in absolute magnitude among the O stars . . . (p. 94) One of the obstacles to accurate classification of the A stars is the presence of several roughly parallel sequences of 'peculiar' A stars and metallic-line stars. (p. 95) The long-standing lack of an adequate set of standard stars of type M has been due to three natural reasons . . . (p. 98) . . . Unfortunately, few of the blue stars in globular clusters are bright enough to have had their spectra well observed . . . Because of the low intrinsic luminosity of the cooler dwarf stars, the number of those for which accurate spectral types are known remains small, and these are confined within distances of a few dozen of parsecs from the sun . . . (p. 107)
>
> We may conclude that the Lick and the **General Catalogue** velocities of the A stars probably require a small positive correction, but its exact amount cannot be found without more comparison material . . . The system of velocities of the B stars can be investigated only by indirect comparisons . . . the control velocities being assigned from observations of solar-type members or A-type members . . . (Petrie, 1969, p. 72).
>
> Determinations of the absolute magnitudes of red dwarfs obtained by various methods are not in complete agreement . . . Since the spectral subclasses of individual stars . . . (in the Mt. Wilson and Yerkes Studies) . . . do not show any variation from the first catalogue to the other two, the reasons for the systematic differences in absolute magnitudes remain obscure. (Vyssotsky, 1969, pp. 193-94).

Moreover, the spectral shifts (redshifts) in the stellar spectra of the various types appear to yield incongruous results and data.

> Some of the comparisons are not well established because of the small number of stars available, but nevertheless it is clear that systematic differences exist . . . It appears to be established that systematic differences do in fact exist between the velocities of the fainter B stars determined at various institutions, although corrections for such differences are not applied in the mean velocities of the *General Catalogue.* (Petrie, 1969, pp. 66-67).

It is quite apparent that the basic properties of stars, such as temperature, radii, and luminosity are not determinable from the spectra of a star, contrary to the whole premises of the Absolute Magnitude method.

> It is anticipated that considerable progress will be made in the comparison of theory and observation of stellar spectra that will improve the relationship between spectral type and effective temperature. This knowledge will then improve the relationship between computed bolometric corrections and spectral type, or color, which at present is rather uncertain. The comparison of our effective-temperature-spectral-type relation . . . indicates that there is still much to be done to improve the relationship. (Harris, 1969, pp. 271-72).

The problems have become so complex and confusing that astronomers are now incorporating theories of stellar evolution into the Absolute Magnitude method. Thus, the basic properties are determined from the star's spectra through the application of formulas which entail use of the star's age and presumed evolutionary development.

> For a star of specified mass M and chemical composition, the radius R and the luminosity L can, in principle, be computed as functions of the stellar age, t, from the theory of stellar structure. The effective temperature T, and the surface gravity g can then be found directly from M, L, and R, again as functions of t. (Stromgren, 1969, p. 185).
>
> The problem of the luminosities of variable stars is neither simple nor single . . . There is no type of variable star for which we can today assign a single definite luminosity. The luminosities of the stars in these groups must be related to their other properties . . . The superficial properties of stars are currently regarded (we cannot presume to say 'understood') in terms of present ideas about stellar development. (Payne-Gaposchkin and Gaposchkin, 1969, p. 448).

Any change in evolutionary theory for a star type would necessitate complete revisions of the computed radii, temperature, and luminosity. If these properties are determined by the age and course of development, and if we are unable to determine them apart from theories of stellar development, then we are faced with the paradox that we will never know anything about the stars inhabiting our universe since we cannot develop accurate theories of stellar development without precise information about their radii, temperature and luminosity, and we will never be able to determine these properties without the correct theory of stellar development. In conclusion, all attempts to classify and categorize the stars into "types" have failed to yield consistent results. In the next article it will be shown how this failure has manifested itself in attempts to determine intergalactic distances.

References

Abell, George. 1973. Exploration of the Universe. Holt, Rinehart and Winston, New York.

Anon. 1976. *Science News.* 109(1):13-15.

Bergamini. David. 1969. The Universe. Time. New York.

Degani, M. H. 1963. Made simple self-teaching encyclopedia: astronomy. Doubleday. New York.

Einstein, Albert. 1961. Relativity, the special and general theory. Crown Publishers. New York.

Harris III, D. L., K. A. Strand and C. E. Worley. 1969. Empirical data on stellar masses, luminosities, and radii in Strand, K. (editor). Basic astronomical data. The University of Chicago Press. pp. 273-92.

Harris III, D. L. 1969. The stellar temperature scale and bolometric corrections in Strand, K. (editor). Basic astronomical data. University of Chicago Press. pp. 263-72.

Keenan, Philip. 1969. Classification of stellar spectra in Strand, K. (editor). Basic astronomical data. University of Chicago Press. pp. 78-122.

Moon, Parry and Domina E. Spencer. 1953. Binary stars and the velocity of light. *Journal of the Optical Society of America.* 43:635-41.

Payne-Gaposchkin, Cecilia and Sergei Gaposchkin. 1969. The luminosities of variable stars in Strand, K. (editor) Basic astronomical data. University of Chicago Press. pp. 448-70.

Petrie, R. M. 1969. Radial velocities in Strand, K. (editor). Basic astronomical data. University of Chicago Press. pp. 64-77.

Roxburgh, I. W. 1977. Is space curved? in Duncan R. and M. Weston-Smith (editors). The encyclopaedia of ignorance. Pergamon Press, Ltd. Oxford, England. pp. 85-89.

Stromgren, Bengt. 1969. Quantitative classification methods in Strand, K. (editor). Basic astronomical data. University of Chicago Press. pp. 123-91.

Vyssotsky, A. N. 1969. Spectral Surveys of K and M dwarfs in Strand, K. (editor). Basic astronomical data. University of Chicago Press. pp. 192-203.

BOOK REVIEWS

Remarkable Record of Job, by Henry M. Morris. 1988. Master Books. Santee, CA. 146 pages. $12.95.

Reviewed by Clifford L. Lillo*

As Dr. Harold Willmington says in his Introduction, Dr. Morris does not take the same approach in his book as have most other writers. While others may have emphasized literary style or attempted to analyze Job's philosophical content, Morris tells us that the *Book of Job:*

> serves as an overview of Satan and his wicked activities.
> supports a literal interpretation of Genesis 1-11 and provides additional details.
> does not deal primarily with the problem of suffering in the lives of godly people (pp. 7, 8).

In eight of the nine chapters, Morris tells us about the book of Job, which, he says, "may . . . be the oldest book in the Bible" (p. 12). In Chapter 5 he analyzes the thoughts and motivations of Job's advisors and tells us what probably led to some of the events. For example, he says,

> The three friends [Eliphaz, Bildad, and Zophar] had evidently consulted together on the matter before they came to Job . . . They must have decided together what they should tell . . . (p. 65).

Another example of the way in which Morris helps the reader to understand the *Book of Job* is his explanation of the "spirit" which appeared to Eliphaz in a dream. According to Morris,

> this mysterious spirit was not God's Holy Spirit . . . it was not one of God's holy angels either . . .
> We conclude therefore, that this was an evil spirit, speaking words of apparent piety and partial truth. In reality . . . they were deceptive and misleading words, for this is how Satan works (p. 66).

Creationists will be especially interested in what Morris has to say about Creation and the Great Flood:

> The Book of Job assumes that God is the creator of all things. There are no references to other gods and no suggestion that the world evolved out of some earlier form . . . God reminds Job that he "laid the foundations of the earth" (Job 38:4). The establishment of day and night by the rotation of the earth is implied in Job 38:12-14 (p. 24).

Morris goes on to show that Job reiterates what Genesis says about the creation of stars, animals, whales, and man himself. Then, in discussing the Flood, Morris says,

> The worldwide flood sent as a judgment from God in the days of Noah was much nearer than the creation to the time of Job, so it is not surprising that there are even more references to the flood than to creation . . . it is possible that Job's experience could have occurred only 300 or so years after the flood (p. 26).

Creationists will find Morris's references to the Ice Age equally interesting. He says,

> There are even hints of the post-flood Ice Age . . . This glacial period did not last for a million years or more, as evolutionary geologists believe, but it could have persisted for several centuries (pp. 29, 30).

To back up his contention, Morris quotes Job 37:9 ". . . cold out of the north"; Job 38:22 ". . . treasures of the snow"; Job 38:29 ". . . Out of whose womb came the ice?" He comments: "The picture of ice emerging as from a womb seems most applicable to the slow advance of glaciers" (p. 30).

The *Book of Job* is often cited by creationists as proof that men co-existed with dinosaurs because of the descriptions given for the behemoth on the land and the leviathan in the sea. With respect to the behemoth, Morris quotes the portion of Job that says, "He moveth his tail like a cedar," and adds, "The reason commentators are unable to identify this mighty animal is that it is now extinct" (p. 115). Regarding sea monsters, Morris quotes Job, "Behold the hope of him is in vain . . . None is so fierce that dare stir him up." (Job 41:9, 10) (p. 118). Morris then concludes, "The leviathan was a real animal, presumably the largest and fiercest of all the aquatic dinosaurs." (p. 119).

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