CRITIQUE OF STELLAR EVOLUTION

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The theory that stars condense spontaneously from interstellar clouds is challenged from several standpoints. Entropy and force calculations are presented, the results of which indicate that such a process would be contrary to the workings of nature. The circular reasoning inherent in astronomical dating methods is discussed, along with a sampling of the many age discrepancies in the literature today. The conclusion from this study is that such dating methods are entirely devoid of scientific value, since they involve guessing at an evolutionary history for the object being dated. Other topics discussed include the alleged serial relationships among stars and problems of planet and galaxy formation.

Today the following doctrines are taught almost universally as fact:

1. All astronomical bodies have condensed from clouds of primordial material such as hydrogen. (When this is considered in conjunction with alleged biological evolution processes, then plants, animals, and people are held to be nothing more or less than descendants of mere hydrogen gas.)
2. Such "creative" processes have been proceeding for billions of years and are still continuing today.
3. These processes are totally spontaneous and self-ordering, ruling out any need for a Creator.
4. Various types of stars such as red giants and white dwarfs are serially related, much as the larva, pupa, and adult stages of insect metamorphosis. One type is said to merge or evolve into another over millions or billions of years. The Creator is thus denied the prerogative of structuring variety or diversity into the original universe. Each star, it is claimed, started as an undifferentiated cloud and has passed inexorably through the prescribed stages.

Little spiritual perception is needed to appreciate that there is something amiss with the theory that human beings have evolved out of hydrogen gas by natural processes. Yet this is only one of the many problems, both scientific and scriptural, that must be reckoned with if the basic framework of stellar evolution is accepted. A number of these problems will be discussed in the course of this paper.

Let us be aware of what is solid experimental evidence on the one hand, and what has been supplied by human imagination on the other. May we have the wisdom to remain firmly grounded on that which is true science.

Observation Lacking

Needless to say, no one has ever watched a star traversing its "life cycle" from "birth' to "death." In fact Abell has likened our most extensive observations on an individual star to observing the aging process in a man, by studying him for only ten seconds out of his lifespan of threescore and ten.[1] The other 69 years, 364 days, 23 hours, 59 minutes, and 50 seconds would have to be inferred by guesswork.

Stuart Inglis, in his *Planets, Stars, and Galaxies,* readily admits, ". . . for any single star we cannot yet tell accurately its age, its past, and its future existence."? In all the heavens there is no star concerning which astronomers have detailed knowledge. Yet when they generalize about *all stars,* they appear quite certain. This is most difficult to understand. Even if far more were known, it would still behoove scientists to maintain an attitude of humility and caution. Not only are we restricted to *present* observations; we are severely limited by the fact that we can only study stars "skin deep" (we see only their surface), and we are forced to view them through interstellar material whose nature and quantity are only poorly understood.

Circular Reasoning

To one who delves into this realm in any depth, it soon becomes apparent that astronomers are guilty of the same type of circular reasoning that is practiced by geologists and paleontologists. Stellar evolution is assumed in making the age estimates of stars. But then the age estimates are used to establish a framework *for* stellar evolution. The following discourse might serve to make this more concrete:

Instructor: "Aldebaran, in the constellation Taurus, is considerably older than our sun."

Student: "How do we know that?"

Instructor: "It has obviously evolved past the Main Sequence up into the red giant region of the Hertzsprung-Russell diagram (See next section) whereas the sun is still *on* the Main Sequence. There is another category of stellar objects called the T Tauri stars that are *younger* than our sun, not having yet evolved *to* the Main Sequence."

Student: "But how do astronomers know that stellar evolution takes place at all?"

Instructor: "Because we find stars of various ages that testify to it. These are snapshots, as it

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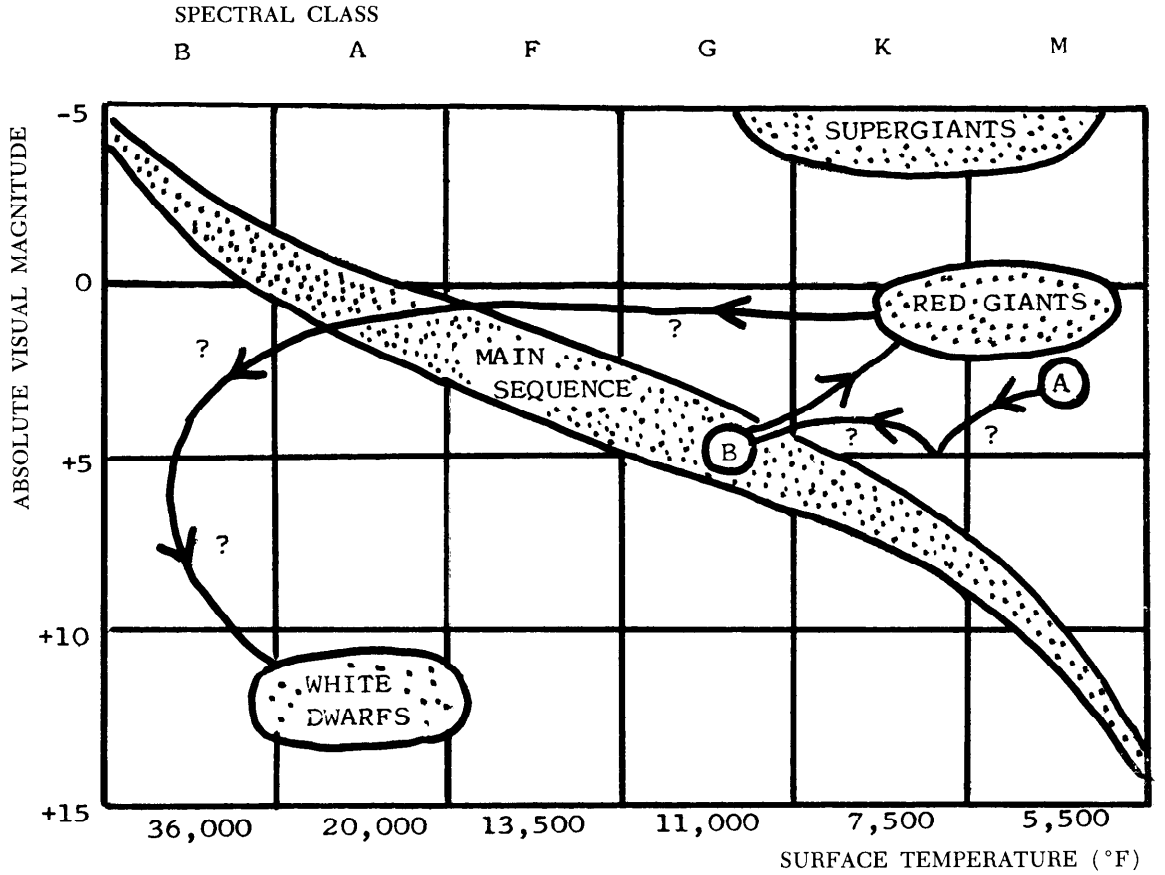

Figure 1. Hertzsprung-Russell Diagram for stars in the spiral arms of our galaxy, showing hypothetical "evolutionary track" for the sun. The track starts with the alleged condensation from interstellar material at "A" and goes through the sun's present position at "B". Eventually, it is claimed, the sun will evolve into a red giant, and finally a white dwarf.

were, of different stages of the process. From these we are able to piece together a logical evolutionary sequence."

Christian students of biology or geology will be only too familiar with this kind of reasoning. Evolution is assumed in establishing the "ages;" then the "ages" are used to establish evolution. Astronomers use the stars instead of the index fossils of biological evolution. Whenever a certain type of star is found, a certain history is automatically demanded. The alternative of direct creation with diversity is not even considered.

The Hertzsprung-Russell Diagram

For the stars in the spiral arms of our galaxy, if one makes a plot of the actual intrinsic brightness (absolute magnitude) versus temperature, then results similar to Figure 1 will be obtained. For most stars there is a clear-cut correlation: the hotter the star the greater its brightness. The majority of stars fall along a diagonal extending from the upper left to the lower right, called the Main Sequence. Our sun, a typical Main Sequence star, is located at "B." Other important categories are the red giants, the supergiants, and the white dwarfs.

The Hertzsprung-Russell (H-R) diagram has long served as a useful descriptive representation for stars in our galaxy. However, in recent years its use has been turned largely to tracing "evolutionary tracks." One such track is included in Figure 1. It purports to trace the life history of our sun from the time of its condensation from interstellar material at "A" to its final demise in the white dwarf "stage" at the lower part of the diagram.

Presumably the Main Sequence consists of stars whose chief energy-producing reaction is the fusion of hydrogen to form helium. The red giants are said to be stars in which all hydrogen has been consumed and only helium fusion occurs.

There are, interestingly enough, more "missing links" than stars along the "evolutionary tracks." This important fact will be discussed in a subsequent section.

The alleged directions of such tracks have been drastically altered in recent years. At one time many astronomers had envisioned evolution down the Main Sequence from left to right. Now the tracks are often at right angles to the Main Sequence. Projecting ahead into the future, we may expect many more changes, as the theories are further adjusted to conform to the whims of the times.

No star has ever been followed through such an evolutionary path observationally. Minor shifts in position on the H-R diagram *have* been observed. Cepheid variables, for example, oscillate both in brightness and in temperature. Novae and supernovae brighten up explosively, moving them upward temporarily on the H-R diagram. But never has one type of star been observed to merge or evolve into another type.

Stellar Aging

Every star is a dynamic system undergoing degenerative changes. The "normal" degenerative processes such as fuel consumption do not produce perceptible changes on the H-R diagram during the length of time that we have been observing stars telescopically. Since only the outermost parts of a star can be observed, it is necessary to guess at the interior composition.

The theoretician therefore devises a *model* that is based on various simplifying assumptions. It is this model that is dealt with so imaginatively in projecting evolutionary processes forward or backward on a time scale that is extended many orders of magnitude beyond what is warranted by the data at hand.

Actually, we do not even vaguely comprehend the makeup of the present universe, let alone what it once was, or what it is destined to become. To extrapolate into billions of years on the basis of a few decades of observations is sheer folly. But scant as these observations may be, they should be faithfully adhered to in erecting the superstructure of the science of astronomy, rather than merely using them as a point of departure for speculation.

Concerning the terminology that is applied to changes in stars it would be far more accurate to use the term "stellar aging" rather than "stellar evolution." The latter implies that there is some kind of upgrading or improvement involved. In all the studies that have been made to date, *only downhill processes* have actually been found to occur: disruption, dissipation, and disintegration. These include:

1. Consumption of hydrogen, a high-energy content fuel, leaving as "ashes" low energy fuels such as helium. The sun, a typical star, consumes four and one half million tons of fuel per second.

2. Radiation of electromagnetic energy and neutrinos into space in all directions, with no possible means of recovery.

3. Loss of material by violent disruptive events, as in novae and supernovae. (It is also suspected that planetary nebulae are formed by catastrophic eruptions in stars.)

4. Spinning off of material to form an expanding stellar atmosphere, as in shell stars.

5. Ejection of energetic particles from a star's surface by mechanisms such as solar flares.

Star Formation

As spontaneous generation is supposed to precede biological evolution, so star formation is said to precede stellar evolution. Herein lies one of the knottiest problems of all. One unusually frank astronomer states:

> Contemporary opinion on star formation holds that objects called protostars are formed as condensations from interstellar gas. This condensation process is very difficult theoretically, and no essential theoretical understanding can be claimed; in fact, some theoretical evidence argues strongly against the possibility of star formation. However, we know that stars exist, and we must do our best to account for them.[3]

The last sentence is not without humor. Stars are "there," presenting a challenge to the cosmic evolutionist, in the same sense that Mr. Everest was "there" as a challenge to Hillary. But why is it that there *are* things which exist that the evolutionist feels no need to account for—such as the primeval hydrogen and the law of gravitation? These things and many others are simply taken for granted.

Another very revealing statement, admitting that star formation seems so improbable that it should never happen, comes from none other than G. R. Burbidge, a recognized authority on the "evolution of elements" in stars: "If stars did not exist, it would be easy to prove that this is what we expect."[4] The problem, simply, is that the condensation of a star from interstellar material would violate a good deal of what we know about the laws and processes of nature.

Practically all of the popular paperbacks, and 100% of the many textbooks that I have acquired, gloss over this problem most superficially. Implicit faith is expressed in the theory that stars condense spontaneously from interstellar clouds by gravitational attraction. As both cause

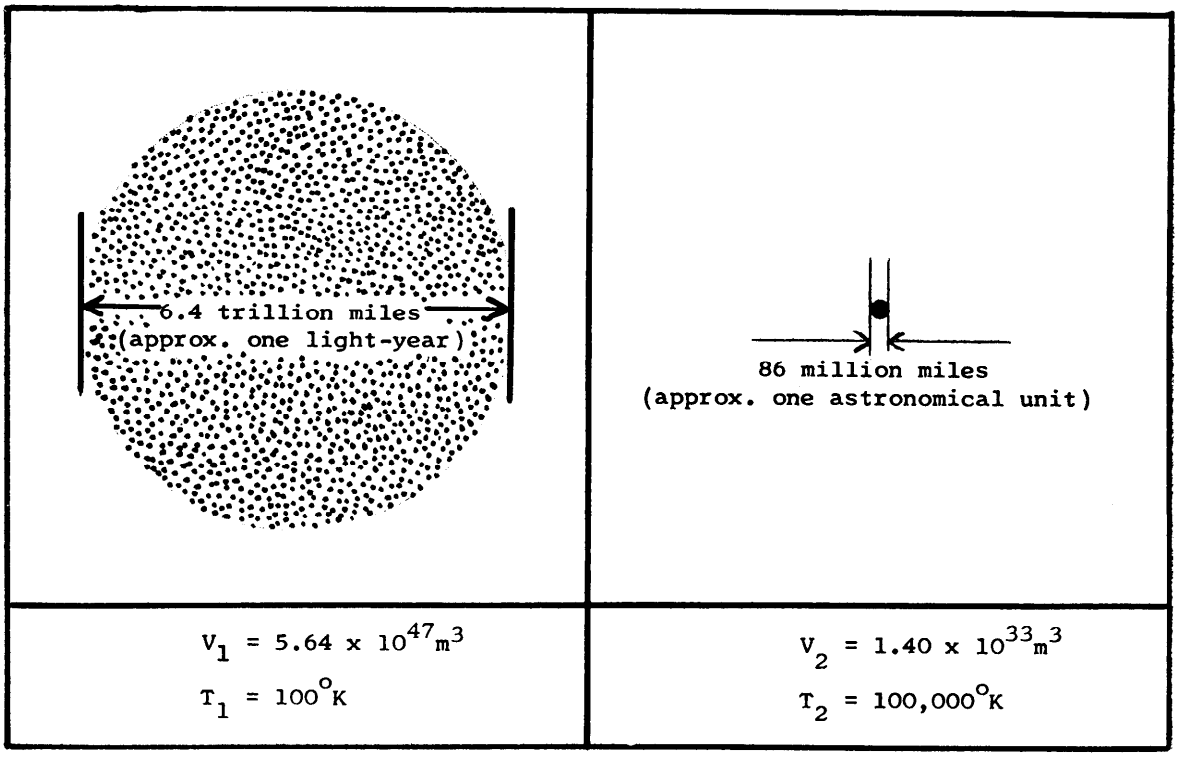

Figure 2. "Before" and "After" sketch of hypothetical condensation to form star. (not draw to scale)

and effect seem to be present, it "makes sense" to the average reader. He readily accepts the idea and reads on to the next speculation. However, precise computations with available data indicate that the alleged process would fail completely.

Calculating with figures given by cosmogonists, we can estimate the entropy change for such a hypothetical condensation. If it turns out that the entropy *increases* in such a process, we must conclude that it is natural and in keeping with the "downhill" trend of nature. If, however, we find that the entropy would have to *decrease*, we have every right to be suspicious; "uphill" processes require organizing intelligence and/or energy from the outside. We would then have to examine whether such could be supplied within the scope of natural occurrences.

I will use for my calculations values suggested by Lyman Spitzer of Princeton in a paper presented at the Goddard Institute for Space Studies in New York.[5] Let us consider an interstellar cloud massive enough to form the sun, 2×10^{30} kilograms. Spitzer gives, as the temperature of the cloud, 100° Kelvin.[6] From a relationship that he gives, its volume can be readily determined, to be 5.64×10^{47} cubic meters.[7]

By the time the radius of the cloud has supposedly shrunk to 100 times the sun's radius (stellar dimensions), its mean temperature is presumed to have risen to 100,000° Kelvin.[8] The volume at this stage is calculated to be 1.40×10^{33} cubic meters.[9] (See Figure 2)

We see that the volume has been reduced by a factor of 400 trillion (the diameter going from about one light-year down to about one astronomical unit) while the temperature has been increased by a factor of only 1000. We might guess already that the entropy would have to decrease in such a process.

Calculation of Entropy Change

Treating the system as an ideal gas (which is an excellent approximation because the material is so spread out) the entropy change may be computed by a well-known relationship found in any standard thermodynamics text:[10]

$$dS = Cp \frac{dT}{T} + R \frac{dV}{V} \qquad (1)$$

where S is the entropy; T, the absolute temperature; V, the volume; C_p, the molar heat capacity at constant pressure; and R is the universal gas constant. Integrating both sides, we obtain

$\Delta S = C_p \ln T_2 - C_p \ln T_1 + R \ln V_2 - R \ln V_1$* (2)

Substituting the values previously discussed for V_1, V_2, T_1, and T_2, and utilizing the ideal gas value of (5/2)R** for C_p, we obtain

$$\Delta S = 5/2\ R \ln T_2 - 5/2\ R \ln T_1 + R \ln V_2 - R \ln V_1$$

Now, as mentioned above, we will call T_2 the temperature existing when the radius has shrunken to 100 times the sun's radius and its value is 100,000° or 10^5 degrees while T_1 was 100° or 10^2 degrees presumed for the interstellar cloud. The volume V_2, when shrunken, is 1.40×10^{33} cubic meters as compared to the original volume V_1 of 5.64×10^{47} cubic meters. By substitution of these values, we obtain

$$\Delta S = (5/2)\ R \ln 10^5 - (5/2)\ R \ln 10^2 + R \ln 1.4 \times 10^{33} - R \ln 5.64 \times 10^{47}$$

Temperature and volume units are dropped because a logarithm is an exponent and as such has no units. To simplify this equation we may substitute the value of 2 cal/mole°K for R and arrive at the following equation:

$$\Delta S = 5 \ln 10^5 - 5 \ln 10^2 + 2 \ln 1.40 \times 10^{33} - 2 \ln 5.64 \times 10^{47}$$

We change to common logarithms or "$\log_{10}$" by multiplying each natural logarithm by 2.3. This changes the base from the natural log base "e" to base 10:

$$\Delta S = (5)(2.3) \log 10^5 - (5)(2.3) \log 10^2 + (2)(2.3 \log 1.40 \times 10^{33}) - (2)(2.3 \log 5.64 \times 10^{47})$$

$$\Delta S = (5)(2.3)(5) - (5)(2.3)(2) + (2)(2.3)(33.146) - (2)(2.3)(47.751)$$

$$\Delta S = 57.5 - 23.0 + 152 - 220$$

$$\Delta S = -33 \text{ eu/mole}$$

The entropy must decrease 33 entropy units for every mole of material in the cloud! The fact that the derived result is negative indicates clearly that the condensation is not a spontaneous process. The temperature term makes a positive contribution, but this is more than offset by the large negative contribution of the volume term.[11] As our scientific intuition might have told us, it is more natural for the cloud to expand than to contract, since we know from laboratory observations that gases expand spontaneously but do not contract spontaneously. Anyone who has ever pumped up a tire by hand and thus concentrated a given amount of air into a smaller volume realizes how much energy goes into such an operation.

Applying the second law to the star formation process, then, we find that the reverse process rather than the forward process is favored. Here is just one more instance where the second law of thermodynamics points to creationism as the only realistic explanation for the origin of the universe we live in.

Calculation of Outward Push

We will also calculate the forces acting at the surface of the original cloud. It can be shown thereby that the outward push due to thermal motion of the molecules, even at 100° Kelvin, is greater than the gravitational pull inward.

The outward push of the cloud can be calculated starting from the ideal gas law

$$PV = nRT \qquad (3)$$

where P is the pressure, V is the volume of the cloud, n is the total number of moles of material in the cloud, R is the universal gas constant, and T is the absolute temperature. Again, this is an excellent approximation because the individual particles are so far apart. Solving for pressure,

$$P = \frac{nRT}{V}$$

The total force outward over the whole surface of the cloud is simply this quantity times the surface area of the cloud.

$$F = PA = \frac{nRTA}{V} \qquad (4)$$

Assuming a spherical cloud, as is customary in the literature, its area and volume would be $4\pi r^2$ and $4\pi r^3/3$ respectively. We have, therefore,

$$F = \frac{nRT\ (4\pi r^2)}{4\pi r^3/3} \qquad (5)$$

By cancellation of $4\pi r^2$ from numerator and denominator and multiplying each by 3, we find that

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*The integral of dT/T equals the natural logarithm of T plus a constant. To evaluate this as a definite integral between the temperatures T_1 and T_2 we substitute T_2 into the expression (lnT + C) and from this subtract the expression with T_1 substituted into it. Thus

$$(\ln T_2 + C) - (\ln T_1 + C)$$

The constants cancel and we have

$$\ln T_2 - \ln T_1$$

Since originally dT/T was multiplied by Cp, our result is multiplied by Cp:

$$C_p (\ln T_2 - \ln T_1), \text{ or } C_p \ln T_2 - C_p \ln T_1$$

The same reasoning holds for transforming RdV/V into $R \ln V_2 - R \ln V_1$.

**Cp is the molar heat capacity of a gas at constant pressure. The cosmogonists generally assume that such a cloud contracts under a constant external pressure, and that the gas is neutral atomic hydrogen. (See Reference #12) Hydrogen in this form is a good approximation to an ideal monatomic gas, whose Cp is (5/2)R.

$$F = \frac{3nRT}{r} \qquad (6)$$

where r is the radius of the cloud. The numerical value of the radius is 5.13 x 10^{15} meters (about 3.2 trillion miles). Assuming the material to be neutral atomic hydrogen,[12]

$$F = 3\left(\frac{2 \times 10^{33} \text{ grams}}{1 \text{ gram/mole}}\right)\left(8.31 \frac{\text{joules}}{\text{mole } ^\circ\text{K}}\right)\left(100^\circ\text{K}\right) \Big/ 5.13 \times 10^{15} \text{ meters}$$

$$F = 9.72 \times 10^{20} \text{ newtons}$$

The *outward* push due to thermal motion of the molecules is found to be 9.72 x 10^{20} newtons.

We shall now compute the *gravitational pull inward* for the whole cloud by the hydrostatic equilibrium relationship:[13]

$$\frac{dP}{dr} = \frac{\rho GM(r)}{r^2} \qquad (7)$$

where r is the radius of the cloud, P is the pressure, ρ (rho) is the density, and M(r) is the mass of the whole cloud expressed as a function of r. Assuming uniform density, M(r) may be replaced by density times volume or $(\rho)\left(\frac{4}{3}\pi r^3\right)$ giving

$$\frac{dP}{dr} = \frac{\frac{4}{3}\pi\rho^2 G r^3}{r^2} = \frac{4}{3}\pi\rho^2 G r \qquad (8)$$

Writing this in differential form,

$$dP = \frac{4}{3}\pi\rho^2 G r dr$$

Integrating from the center of the cloud to the edge,

$$\int dP = \int_0 \frac{4}{3}\pi\rho^2 G r dr$$

$$P = \frac{2}{3}\pi\rho^2 G r^2 \qquad (9)$$

The total force inward at the surface is this quantity times the area of the surface, which, as before, is $4\pi r^2$:

$$F = PA = \left(\frac{2}{3}\pi\rho^2 G r^2\right)(4\pi r^2) \qquad (10)$$

which simplifies to

$$F = \frac{8}{3}\pi^2\rho^2 G r^4 \qquad (11)$$

When we substitute $M/\frac{4}{3}\pi r^3$ for ρ, the expression reduces to

$$F = \frac{3GM^2}{2r^2} \qquad (12)$$

Substituting MKS values,

$$F = \frac{(3)(6.67 \times 10^{-11})(2 \times 10^{30})^2}{(2)(5.13 \times 10^{15})^2}$$

$$F = 1.52 \times 10^{19} \text{ newtons}$$

The inward pull at the surface of the cloud due to gravitational attraction is found to be 1.52 X 10^{19} newtons.

Let us now compare the outward and inward forces at the surface of the cloud:

$$\frac{F \text{ outward}}{F \text{ inward}} = \frac{9.72 \times 10^{20}}{1.52 \times 10^{19}} = 64$$

The cloud has 64 times as much outward force as inward; it therefore has a greater tendency to expand than to contract. Let us keep in mind that we allowed a leading cosmogonist to choose the initial conditions for the cloud. We gave him the advantage of choosing his starting materials and circumstances, but the results of the calculations are *still* seen to militate strongly against star formation.

When we apply the same equations to the condensed material (the material at V_2 and T_2 having a radius slightly less than the radius of the earths orbit) we see that here gravitation *is* in fact causing the material to contract.[14] But how it was reduced to that volume in the first place is impossible to understand, short of direct creation.

From equations (6) and (12) used above it can readily be seen that an object which already possesses stellar dimensions will exhibit a strong gravitational pull inward, easily overcoming the thermal push outward:[15]

$$F = \frac{3nRT}{r} \quad \text{(thermal push outward)}$$

$$F = \frac{3GM^2}{2r^2} \quad \text{(gravitational pull inward)}$$

The outward force is inversely proportional to the radius, while the inward force is inversely proportional to the radius *squared.*

In general, therefore, the smaller the object the more successfully it can contract, provided equilibrium has not yet been reached. But the enormous clouds that are fashionable among theoreticians today (those that are supposed to produce stars in groups of hundreds of thousands) are extremely unfavorable for contraction. *Gravitation avails little at such a radius.*

More Speculation Introduced

How, then, do they propose to make the star formation process "work?" With the second law of thermodynamics working against them, and gravitation failing to overcome the thermal force outward, are they not ready to concede defeat? Never!

Some fertile mind can always concoct a scheme to get around the laws of nature—at least on paper. The scheme that is invoked here is simply this: surround the cloud you wish to compress with a *hotter* cloud, so that the molecules at the surface of the inner cloud will be bombarded by the faster moving molecules of the outer cloud and pushed inward. By stacking the deck in this manner, enough brute force can allegedly be mustered to render the impossible possible.

As Spitzer describes it, the 100°K cloud we wish to compress must be surrounded by a second cloud having a temperature of l0,000°K, the inner cloud being neutral hydrogen, the outer, ionized hydrogen (HI and HII regions, respectively, in astronomical parlance)[16]. Unfortunately for the theory, however, it is questionable whether HI regions occur in such pockets surrounded by HII regions.

The realistic situation appears to be just the opposite. According to Bart Bok, HII regions are generated by very hot O or B class stars*, and expand against the surrounding HI region.[17] But in order to make the above-mentioned scheme work, an HI region would have to be providentially enclosed within an HII region, over 4π stearadians of solid angle, *contrary to observation*.

By rigging the starting conditions in this manner Spitzer leaps over a number of problems without ever facing them. The inner cloud, being 100 times cooler than the outer, is already much more condensed than its surroundings at the very outset. How did it get that way?

The 10,000°K that Spitzer postulates for the outer cloud is more than half again as hot as the sun's surface. How could an extended region of interstellar material attain such a temperature? Heating by nearby stars? How, then, did the first stars condense before there were other stars present to heat up the gas? It is reminiscent of the chicken-versus-egg dilemma encountered in Whipple's Dust Cloud Hypothesis, discussed in an earlier paper.[18] In that instance, light pressure from other stars was imagined to concentrate the material into a smaller volume.

Perhaps the most ludicrous part of the whole hypothesis is the cosmogonists' naive faith that the hot and cold clouds will remain unmixed over many millions of years (Herbig gives a figure of 50 million years!) while the condensation process is in progress! But an avid pantheist credits "Nature" with many great and mighty powers, including the ability to violate its own laws.

*Stars are classified according to their spectra into seven major divisions: O, B, A, F, G, K, and M. The class O and B are bluish-white stars possessing unusually high surface temperatures-greater than 25,000°K for the class O, and 11,000-25,000 for the class B. (This is considerably hotter than the sun which has a surface temperature of about 6,000°K.)

Other Star Formation Difficulties

Turning now to other types of difficulties connected with star formation, we note that there is a serious angular momentum problem. The original cloud would be rotating slightly, due to differential galactic rotation (a surface velocity of about 100 meters per second.)[19] If the cloud were to contract to a star with strict conservation of angular momentum, the surface velocity of the star would be greater than the speed of light![20] Thus the cosmogonist finds himself embarrassed by too much angular momentum and he is forced to imagine mechanisms for disposing of the excess. So far, the schemes that have been proposed have been notably lacking in credibility.

Still another big question mark concerns the strength and topography of the magnetic field throughout the galaxy. If the field intensity is as high as 2×10^{-5} gauss, star formation will be "in difficulty."[21] One widely held view is that the field is parallel to the spiral arms of the galaxy, and is indeed as strong as 2×10^{-5} gauss.

However, whenever a question exists due to lack of experimental evidence, the cosmogonists have a habit of giving themselves the benefit of that doubt.

All in all, Spitzer does not seem completely sold on the scheme that he outlines. This is evidenced by statements such as the following: "It should be emphasized that all this discussion is quite tentative and serves principally to point out some of the problems involved."[22] After listing the hypothetical stages in star formation he states, "As one indication of the many uncertainties in star formation theory, it should be noted that possibly some of these stages do not even arise during the actual process of star birth."[23] Thus the man, who is probably the leading authority on the subject, appears to have numerous reservations concerning the details of the process. Yet faith abounds that the process does in fact take place, and that it is a common everyday phenomenon throughout space and time.

Journalists are always anxious to produce sensationalistic copy bearing a headline such as "A Star is Born," or "Birth of Star Appears Imminent." A UPI release of October 2, 1967 declared that mankind may be treated to the grand spectacle of the birth of a star within the next 20 years. Based on a somewhat misquoted *Scientific American* article by George Herbig, the release stated that the Orion Nebula (Figure 3) is being watched closely in hopes that the "gestation period" of some "protostar" will soon be completed.

Figure 3. Great Nebula in Orion (M42). Astronomers are watching this nebula closely in hopes of seeing "the birth of a star" in the next few years. However, even if such a process were theoretically possible, such an event could never be definitely verified. If a "new" star is seen, it could simply be due to the thinning of interstellar dust in front of a star that was already there.

There is one serious problem concerning observational verification when studying such a nebula. If a "new" star is seen, it could simply be due to the thinning of interstellar dust in front of a star that was already there. This fact has been soberly admitted in the literature but has yet to find its way into the news media.

Scripture seems clear on the fact that the heavens were fully structured at the end of the Creation week. Genesis 2:1 declares "Thus the heavens and the earth were finished, and *all the host of them."* The 33rd Psalm also conveys the impression of a divine fiat that brought the stars suddenly into existence: "By the word of the Lord were the heavens made; and all the host of them by the breath of His mouth. . . For He spake, and it was done; He commanded, and it stood fast." (Psa. 33:6, 9) Again, in Exodus 20:11 we read, "For in six days the Lord made heaven and earth, the sea, *and all that in them* is, and rested the seventh day. . . "

Galaxy Formation

From the foregoing discussion it will be appreciated that condensations of "primordial material" are most problematical. On the galactic level, however, the difficulties are present on a far grander scale. In the case of our own galaxy, at least, one must explain the intricate makeup of the disc—its nucleus and spiral arms containing some 100 billion stars, the hundred or so globular clusters (each containing several tens of thousands of stars) that revolve around the galaxy as satellites, and the galactic corona. (See Figure 4)

Many cosmogonists have been unwilling to tackle the question of galactic origins. Alfvén displays a healthy respect for the problem admitting readily that our "knowledge" of star formation does not appreciably enhance our understanding of galaxy formation:

> But even this approach to an explanation eventually leads us into serious difficulties.

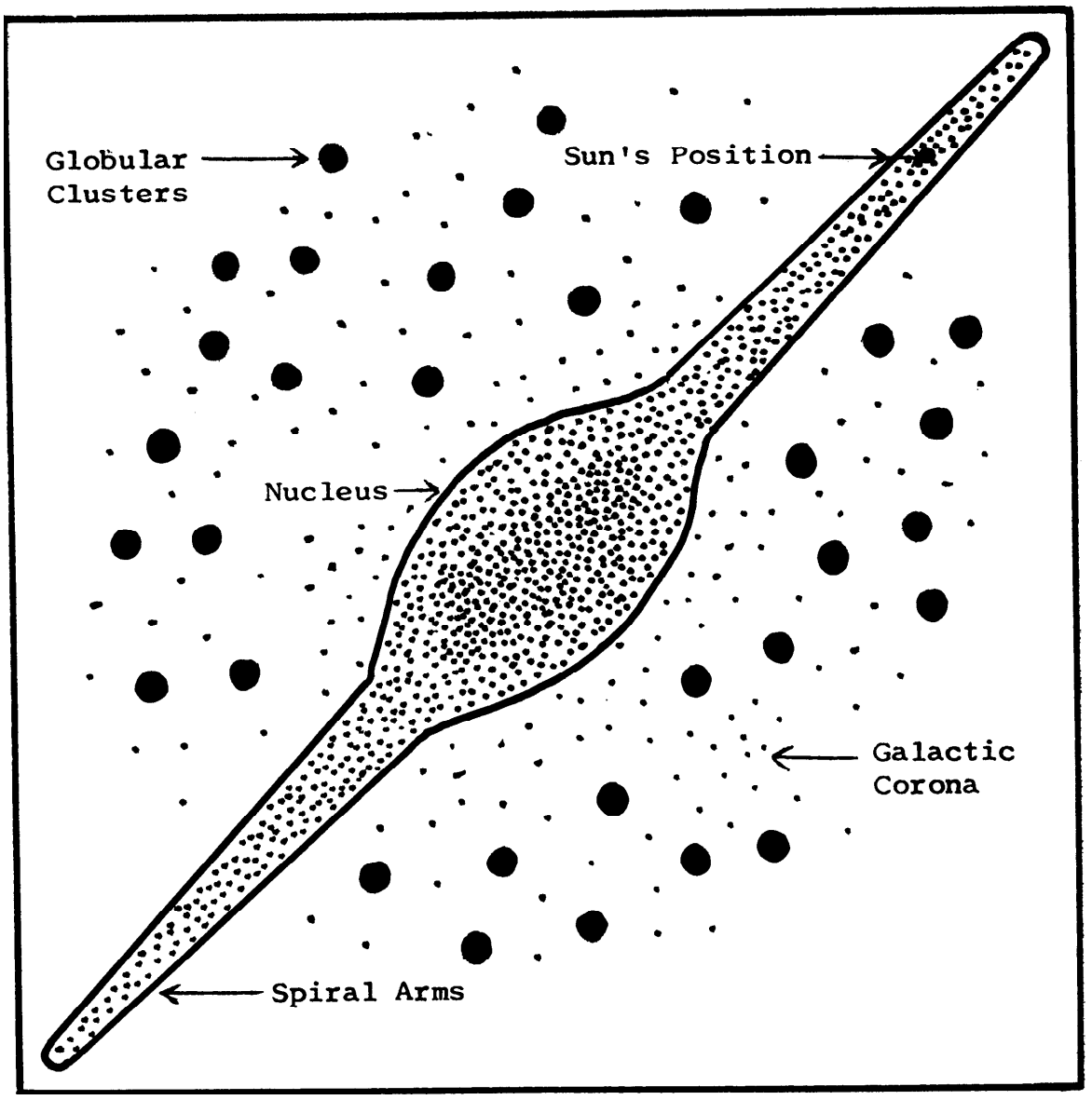

Figure 4. Our galaxy, edge-on view, showing galactic corona and globular clusters (satellites of the galaxy). No evolutionary theory has explained the origin and maintenance of the galaxy or its satellites.

To begin with, the analogy with star formation is of little help because our grasp of its later phases is still dim. Further, we should not expect any major resemblances because the end product, a galaxy, differs so much from a star, and not only in size. Even more serious is that the theory of star formation assumes that the condensing mass consists exclusively of koinomatter (regular matter). The theory, of course, readily lends itself to antimatter, but it falls down when confronted with a mixture of koinomatter and antimatter: an ambiplasma. By its very nature, ambiplasma must incur annihilation, which may be of fundamental importance.[25]

The early stages of galaxy formation are incomprehensible enough, but, he adds, "The further development of galaxies poses a much more formidable problem."[26] The Encyclopedia Brittanica concurs with this view, terming this whole area "a challenge to cosmogonical thought."[27]

While the popular literature on the subject speaks blithely of "protogalaxies" as though they were an everyday reality, none has ever been observed, and no satisfactory model of one has ever been put on paper.[28]

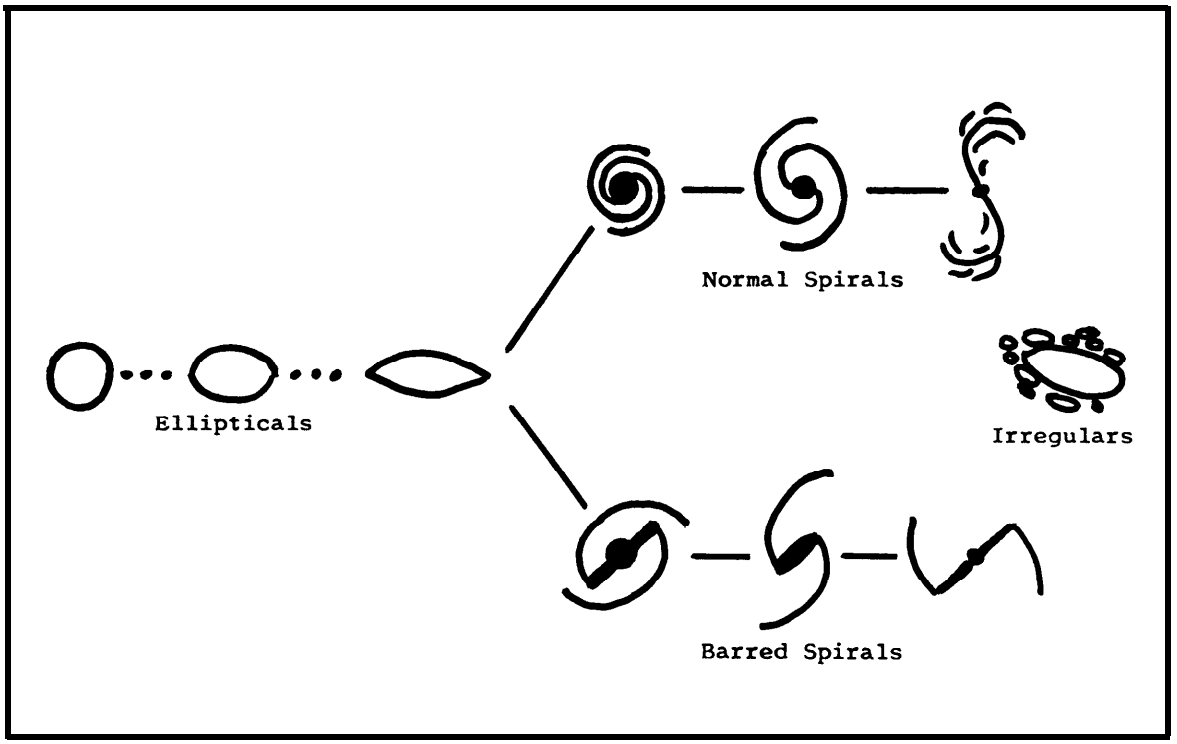

Figure 5. Hubble "Tuning-Fork" Diagram of galactic types. Hubble believed that galaxies evolve from left to right along the upper route; Shapley held that the evolution was from right to left. The consensus today is that galaxies do *not* evolve from one type to another.

Galactic Evolution

Do galaxies gradually evolve from one type to another over millions or billions of years? The current view is that *they do not.* Just how this position has become respectable constitutes an interesting historical study.

We find in the heavens several distinctly different types of galaxies-normal spirals, barred spirals, ellipticals of varying degrees of flatness, and irregulars. Several decades ago Hubble arranged these into his well-known "tuning-fork diagram" shown in Figure 5. It was his belief that galaxies evolved from left to right on the diagram starting with a round elliptical, gradually flattening, and eventually developing into a spiral type via the upper route. Finally, he proposed that they lose all structure from their spiral arms and form an irregular galaxy.[29]

Shapley, on the other hand, felt it more reasonable that they should evolve from right to left. But the important thing seemed to be that, at all cost, they should *evolve.*

In both schemes the upper route of the fork was followed, and no satisfactory explanation was offered for the existence of the barred spirals—those possessing a straight bar-like structure at their center. Even today these constitute a real puzzle. Hodge states:

> Another important dynamical problem that is not solved is the problem of explaining the existence of the bars in the barred spiral galaxies. These masses of stars do not obey any reasonable dynamical model and may be held in place by some nongravitational force such as a strong magnetic field. Just how this can work is not yet known[30] (See Figure 6)

The barred spiral galaxies are best explained by a recent Creation. On the basis of what we know today, these structures must be extremely young, or the bars would long since have been bent into spirals in keeping with Kepler's Second Law.

Neither the Hubble nor the Shapley theory was based on actual physical evidence. Today it is generally felt that angular momentum considerations rule out such evolution from type to type. Abell summarizes the situation as follows:

> There is much doubt, however, that galaxies evolve from one type to another at all. The fact that different kinds of galaxies are flattened by different amounts almost certainly results from their having different amounts of angular momentum—that is, from their different rotation rates. In other words, galaxies might always have had essentially their present forms (at least since their formation),

Figure 6. Barred Spiral Galaxy in Eridanus (NGC 1300). Astronomers are at a loss to explain how the bar is maintained over long periods of time. The problem is solved very neatly by a recent Creation.

> the form of a particular galaxy depending mostly on its mass and angular momentum per unit mass.[31]

It is gratifying to see that many astronomers are no longer attempting to make a dichctomy between "young" and "old" galaxies. Hodge writes:

> Our conclusions, then, are that the sequence of the classification of galaxies is not an evolutionary sequence . . . The best evidence available now indicates that they are all of approximately the same age, at least all of those near enough to our galaxy for this to be estimated.[32]

The Problem of Planets

Although there remains an unshakeable confidence among the general pseudo-intellectual public that the earth and other planets condensed from "the same cloud that formed the sun," the real savants in the field are at a loss to explain just what is supposed to make the small particles of material aggregate together into a larger body (if indeed one can even take the smaller particles for granted).

Thomas Gold of Cornell, writing on "Problems Requiring Solution," lists as Problem No. 1: "the method of agglomeration of solid pieces. How do they manage to stick together, especially over a certain range of size?"[33] Iron particles, he submits, might stick together by magnetism up to a certain size but beyond that there is a "difficult gap between objects that are centimeters or a meter in size, and those that are gravitationally active (a kilometer or more in size)."[34] "This gap is the most difficult to bridge, because as yet gravitation is not in the picture."[35] He then mentions the possibility that comets might form nuclei of accretion, but fails to explain where they came from.

Hoyle takes a different tack. He has conceived the ingenious idea of freezing the fragments together with water.[36] Unfortunately, however, he fails to disclose where his H_20 was synthesized. Also, he concedes the possibility that heat from the sun could melt the ice and sabotage the whole scheme. It is also well to note here that all space probe analyses of planets in our solar system to this date indicate an absence of extra-

terrestrial water. It is questionable then whether one should feel free to postulate water elsewhere in space as Hoyle does.

An earlier idea of Hoyle's involved the use of oil or pitch as a binding agent. Virtually everything from "chewing gum" to "baling wire" has been attempted to fasten planets together, but still the problem remains.

The December 23, 1966 issue of *Time* carried a typical sensationalistic article concerning the imagined formation of another solar system in the constellation Monoceros. Based on a paper by Low and Smith in *Nature*,[37] the article described observations on the twelfth magnitude star, R Monocerotis. The object, according to the details given in the original paper, is nothing more or less than a hot star surrounded by a thick blanket of gas and dust. And yet the paper was given the very presumptive title, "Infrared Observations of a Preplanetary System."

There is no experimental evidence presented that the object is indeed contracting as it is supposed to be. It may actually be expanding from the heat of the star. In fact, much of the observed debris may have been spun off from the star; nothing is securely established concerning the rotation of the star *or* the cloud. Thus, what may well be just another degenerative phenomenon, has been interpreted, with a generous measure of wishful thinking, as a "creative" process,

Let us keep firmly in mind the stark fact that our solar system is the only planetary system that has ever been observed. All the other billions of solar systems that are supposedly out there somewhere have been inferred by very questionable statistical rationalizations rather than solid physical evidence.

What *have* been observed are several binary systems in which one member of the system is extremely dim or even dark, and hence invisible with our best telescopes (astrometric binaries). In such a case the existence of the companion is *inferred* by the wavy path of the bright member. The best authorities still disagree on whether such a dark object should be considered an oversized planet or a small star.

Multiplicity of Star Types

One might derive the impression that, compared to the biological world, the stellar world is somewhat monotonous—that there are stars, stars, and more stars. This is hardly the case, however. Their diversity in both structure and function is staggering. Indeed, "one star differeth from another" (I Cor. 15:41) to the extent that no two are exactly alike.

Stars can differ in size, mass, density, color, brightness, temperature, rotation rate, composition, spectral lines or bands, stability, magnetic field strength, nature and extent of atmosphere or envelope, period (for variable stars), radio emission, corpuscular radiation, and many other factors such as whether they are single, binary, or members of a more complex system.

Ideally, there should probably be as many categories of classification as there are stars. But for practical reasons some fairly broad arbitrary groupings have been set up. Even an abridged list of the types of stars and stellar objects that are encountered in the literature would be too lengthy to include in this paper.

"Missing Links"

The burden of proof is upon the evolutionist, who claims that every object is serially related to other objects, to demonstrate observationally the *intermediate* stages between the various types. In many cases there has not even been a theoretical treatment of the imagined transition. Some of the specific obstacles that exist will be considered at this point.

(1) **Pulsating Stars** are unstable stars that alternately increase and decrease in brightness. There appears to be an accompanying oscillation in size, like a balloon being alternately inflated and deflated. Many distinctly different types exist; a few of which are (a) the RR Lyrae variables, with short periods of from 0.3 to 0.7 days; (b) the classical Cepheids, with periods of 1 to 50 days; (c) the W Virginis variables, with similar periods but 1 to 2 magnitudes fainter; (d) Mira-type variables, with long periods of from 80 to 1000 days; (e) semi-regular variables; (f) irregular variables; and (g) spectrum variables.

How a "normal" star is supposed to lose its stability and evolve into a pulsating star is indeed a great mystery. And how it is then supposed to regain its stability and evolve into still another type is equally baffling. Inglis concedes, "Why the star began to pulsate in the first place is not understood completely, but we know that some unbalanced forces must have developed that caused an initial expansion or contraction."[38]—which is about as specific as the Delphic Oracle. Obviously the question concerns the internal structure of stars which cannot be observed; hence guesswork and imperfect, oversimplified models are the only tools at our disposal.

(2) **T Tauri Stars** are highly unstable reddish objects that are claimed to be the link between interstellar clouds and Main Sequence stars. Well over a thousand of these stars have been identified in the galaxy.

But the T Tauri stars differ radically from the model predicted by stellar evolution theory. They are surrounded by thick and highly active outer atmospheres. Rather than pulling in matter from the surrounding space as might be ex-

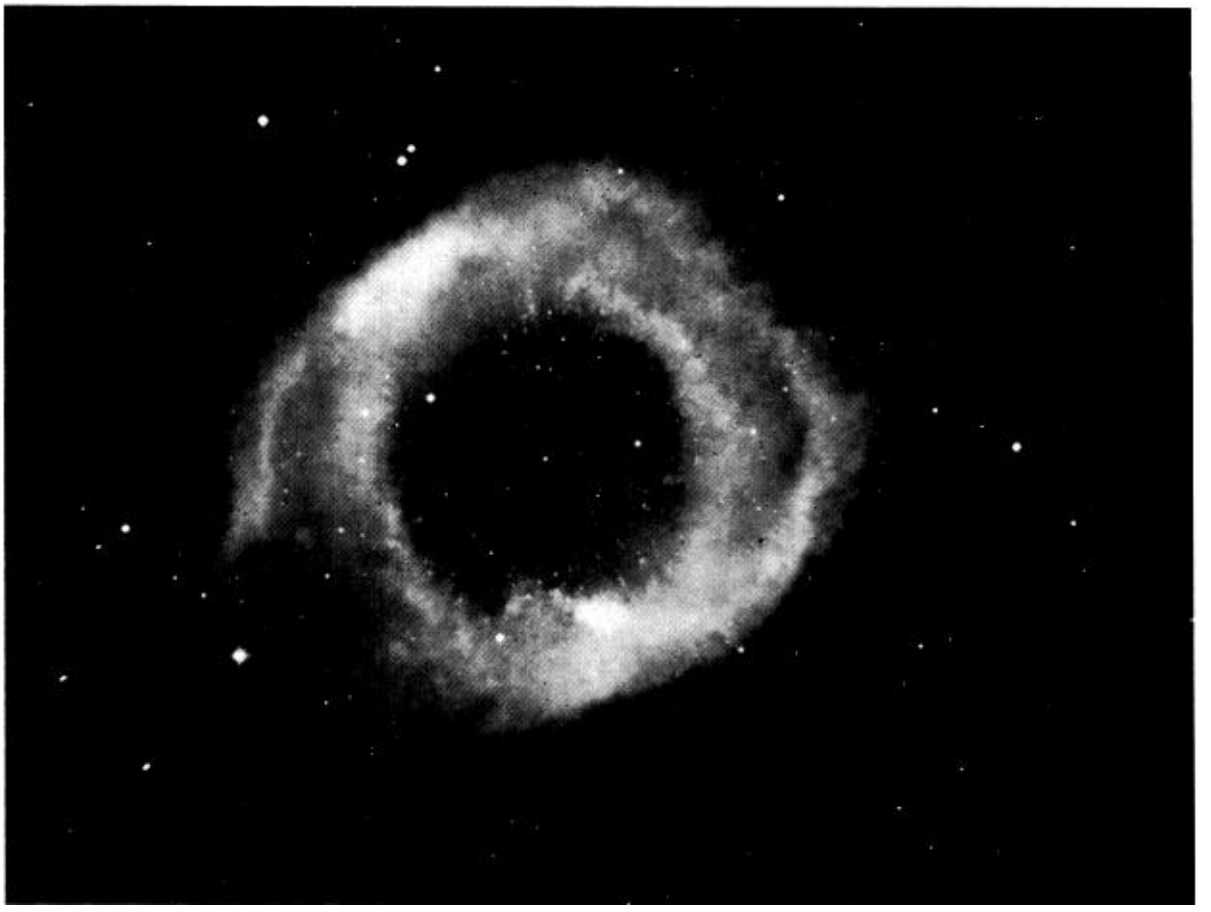

Figure 7. Planetary Nebula in Aquarius (NGC 7293). Such nebulae are alleged to be an evolutionary link between red giants and white dwarfs. However, none has even been observed in the process of evolving *from* anything else or to anything else.

pected, they are ejecting vast quantities of material *from* the star! Also they show a great overabundance of lithium, which would have no conceivable means of building up to that level during the star's "short" history, especially considering that thermonuclear reactions have supposedly not yet started.

George Herbig, astronomer at Lick Observatory, after discussing these peculiarities at some length, presents this summary:

> What physical processes or attributes could account for the distinctive features of the T Tauri stars: Their extremely active and luminous chromospheres, their massive ejections of surface material, their variability in brightness, their high lithium abundance? None of these phenomena are predicted by the modern theory of the contraction of young stars. Each is still a complete mystery.[39]

The logical conclusion is that the T Tauri stars are *not* the link between interstellar gas and Main Sequence stars that the theorists are so desperately seeking; the "real link" must still be missing.

(3) Planetary Nebulae are slowly expanding shells of gas surrounding certain very hot stars. (See Figure 7) Stellar evolutionists have been, for some time, trying to establish planetary nebulae as a link between red giants and white dwarfs. It is generally agreed that they have a catastrophic origin such as an eruption of the central star. But, according to Meadows, ". . . no explosion producing such a nebula has ever been observed."[40]

Perhaps the leading authority on planetary nebulae today is Lawrence H. Aller of U.C.L.A. who states in a recent article, ". . . we may someday find a young object that is evolving into a planetary . . . but none is now known."[41]

Inglis reviews several "possible candidates for the job of supplying the universe with planetary nebulae" such as novae, Wolf-Rayet stars, RR Lyrae stars and red giant irregular variables, and concludes, ". . . none of these seems

to fill the bill completely; astronomers are left with another puzzle to solve."[42]

(4) **White Dwarfs** are extremely small stars that are thought to consist mostly of "degenerate matter"—that is, matter that is presumed to have collapsed to a fantastically high density. (The possibility that they were created *as* white dwarfs is not even entertained as a hypothesis.)

Current dogma has it that red giants evolve into white dwarfs. We are told that our sun will some day go the way of all stars that have exhausted their supply of hydrogen—dissipating itself to become a red giant, and then somehow collapsing into a white dwarf. However, the "route" that is taken on the Hertzsprung-Russell diagram to reach the white dwarf "stage" is only surmised by compounding hypothesis upon hypothesis. According to Brandt, "Precisely how the future sun reaches this area of the H-R diagram is unknown. The path may be along the sequence of subluminous hot stars . . . since these objects are commonly thought to be very advanced in their evolution."[43] Obviously, guesswork abounds.

Abell concurs: "The evolution . . . from red giant to white dwarf is speculative only. Perhaps the star goes through a stage of variability, or emits material as a planetary nebula."[44]

We become increasingly suspicious when we note that some astronomers claim white dwarfs to be remnants of supernovae, while others maintain that white dwarfs evolve into supernovae! Regardless of what the facts may eventually turn out to be, evolution must, for the present, be served.

It should be apparent to the thoughtful Christian that the entire system of stellar evolution has been built upon a premise that is implicitly atheistic. The uniformitarian mind demands that every astronomical object be explained by some "previous stage of development." Never is there a willingness to admit a bona-fide Creation at *any* point.

Age Discrepancies

One of the more entertaining aspects of this study is a consideration of some of the inconsistencies that come up with respect to the cosmic time scale. When modern theorists attempt to force an evolutionary framework upon a degenerating universe, such discrepancies are bound to occur, and many of the problems become increasingly worse the more that is done for them.

(1) **Age of Universe:** Let us compare the age of the universe according to various authorities in the field of astronomy. Their lack of agreement should speak volumes to us concerning the reliability of their dating methods:

Estimated Age of Universe	*Authority*
4.3-5 billion years	Gamow[45]
7 billion years	Peebles and Wilkinson[46]
l0-15 billion years	Ashford[47]
70 billion years	Shklovski[48]
trillions of years	Alfvén[49]
infinitely old	Hoyle[50]

One thing is eminently certain. Not all of these men can be right. Yet at least four of them are considered to be first-rate cosmogonists.

What "dating methods" are used? The cosmogonist simply picks a number that he feels is large enough to encompass all the imagined evolutionary processes of ages past. But no two men can quite reach agreement as to what *has* taken place in the past.

Would any of these men be willing to face an honest Creation at the time in the past specified? Of course not! They have a most evasive way of dealing with the problem of Creation, pushing it farther and farther back in time, but never coming to grips with the real heart of the matter. Typical of the cosmogonists is Alfvén who says, "We beg leave to sidestep the question, 'What happened before then?'"[51] Prior to this point in time the "model" ceases to be "relevant for us."[52]

The smaller estimates are based on inferred recessional velocities of distant galaxies as calculated from observed red shifts. Implicit in such a calculation is the assumption that the red shifts (displacement of spectral lines toward longer wavelengths) are in fact due to a Doppler effect. There are today astronomers, such as Gerald Hawkins of Boston University, who do not accept this interpretation.[53] Most frequently the alternative explanation that is offered involves some sort of "tired light" phenomenon.

Recent research on quasars has rendered the Doppler interpretation more than a little questionable. *One quasar displays five different red shifts.* The following is taken from the 1968 news bulletin of the American Institute of Physics:

> Experimental and theoretical work being done at the University of California (San Diego), Kitt Peak Observatory in Arizona, and California Institute of Technology shows that several different red shifts can be fitted to the absorption spectra of a single quasar. In the most extreme case, one quasar displays 5 red shifts that range from 1.36 to 2.20. Obviously only one red shift can be due to the motion of the entire object, so something must be proposed to account for the others.[54]

(2) **Spiral Galaxies:** A very serious age discrepancy is observed in the spiral arms of gal-

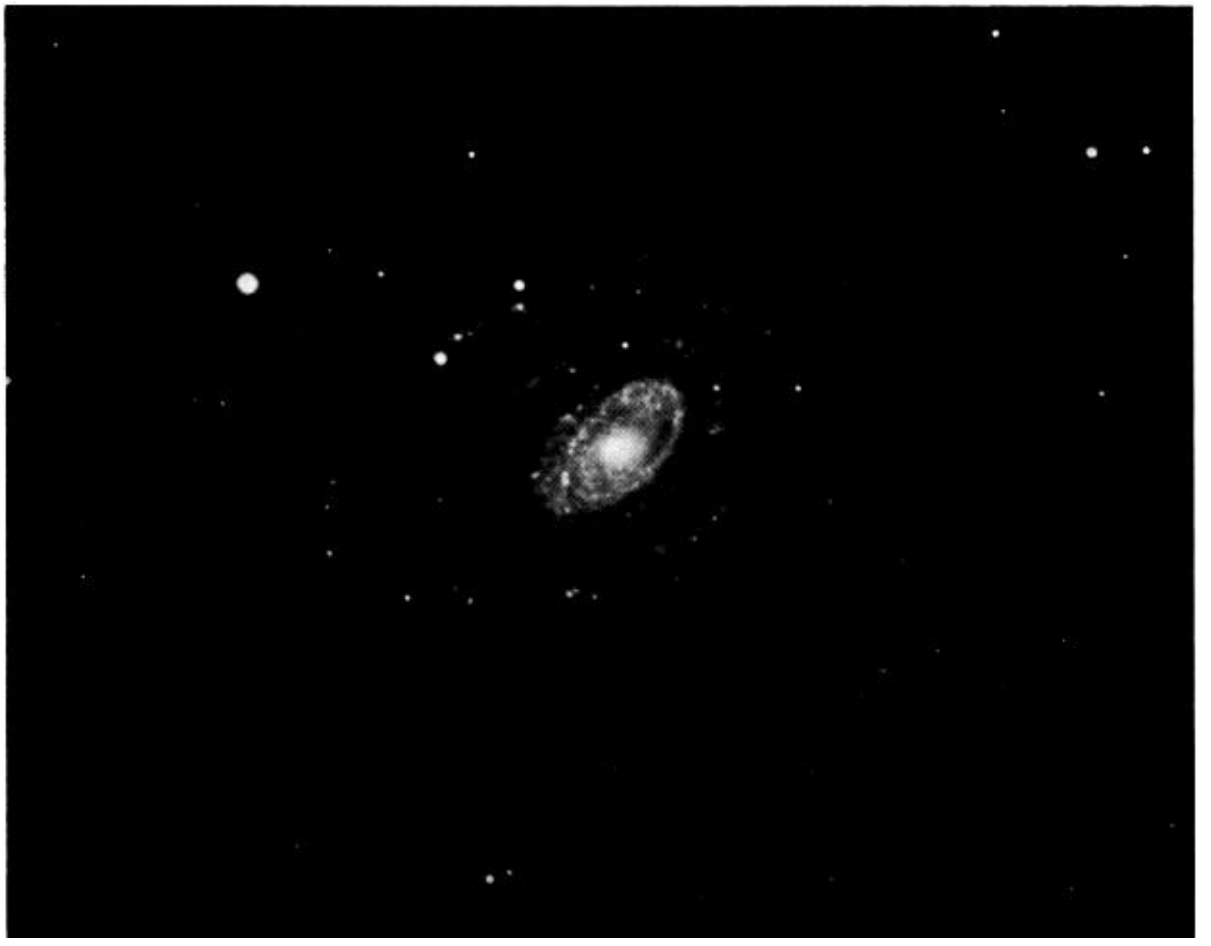

Figure 8. Normal Spiral Galaxy in Virgo. If such galaxies are as old as is claimed, their arms should be wound up 100 times. In actuality the rarely exhibit more than two complete turns. This is possibly the most glaring age discrepancy facing astronomers today.

axies. This writer first became aware of this source of embarrassment to evolutionists when reading *Galaxies and Cosmology* by Paul W. Hodge several years ago. Hodge presents the problem as follows:

> The rotation times for spiral galaxies are approximately 10^8 years, halfway out from the center, but the ages of the spiral galaxies are approximately 10^{10} years. Therefore, one would expect that a spiral arm formed at the beginning of the galaxy's history would now be wound up 100 times. In actual fact most spiral arms of galaxies show only one or two complete turns.[55]

A typical spiral galaxy is shown in Figure 8. If it were as old as is claimed, it would be coiled up into a tight disc, with no lanes showing between the hundred or so turns in the arms.

Theoreticians had hoped that the difficulty could be resolved rather simply by showing that the entire galaxy turns as a unit—that the arms are frozen into a permanent shape by a magnetic field. But Halton Arp of the Mount Wilson and Palomar Observatories rejects this explanation in a recent article: "The magnetic field which runs through the gas in an arm is not strong enough to give appreciable rigidity, and in any case the stars are not coupled to this magnetic field."[56]

Something else was therefore proposed—the density-wave theory. According to this idea, alternate regions of condensation and rarefaction rotate around the galaxy at constant velocity. However, Arp quickly shows that this is no panacea either: ". . . There is a whole class of spirals that contain little or no disc in which the density waves could be transmitted."[57]

Arp then suggests that the spiral arms may simply be the tracks of material ejected from the galactic nucleus. Differential rotation would form such tracks into a spiral pattern. However, Arp fails to give a convincing explanation of

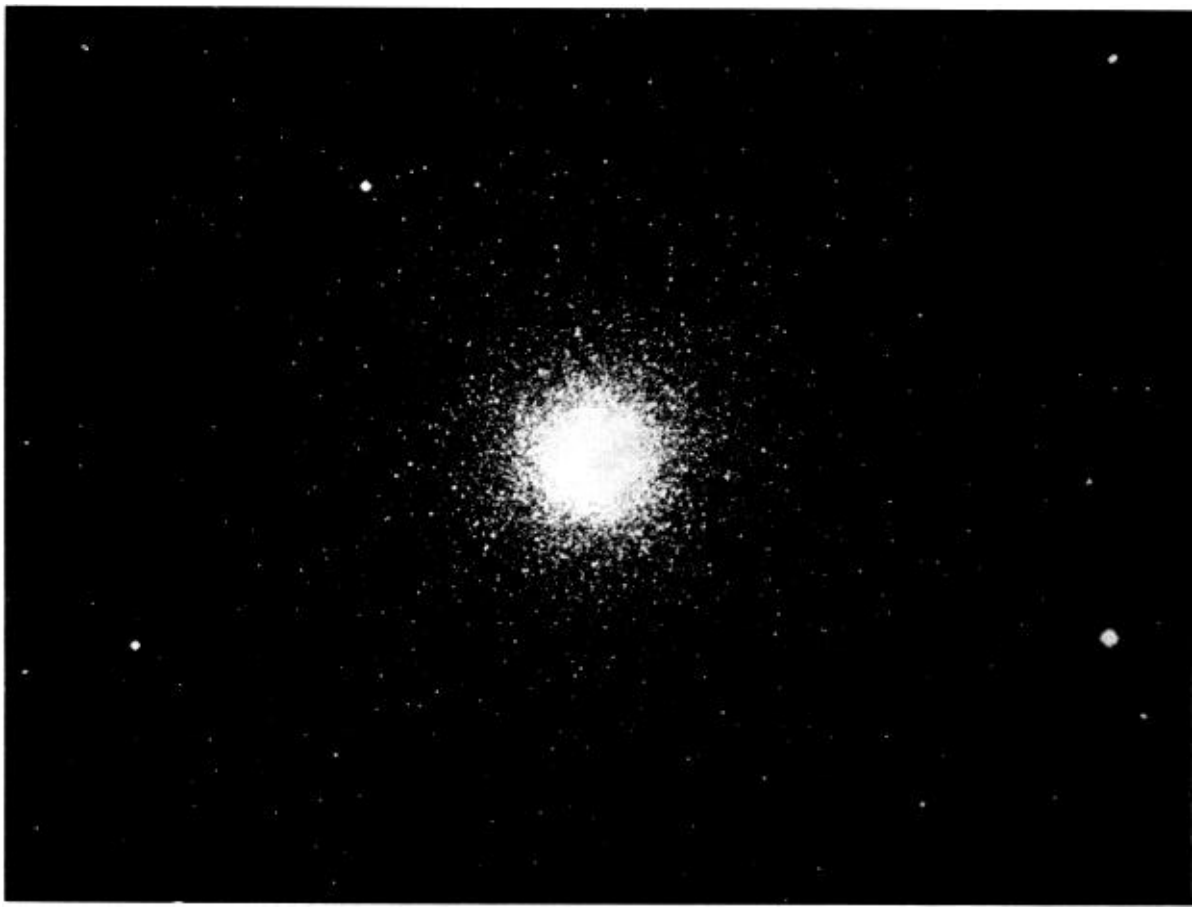

Figure 9. Globular Cluster in Canes Venatici (M3). The age of this cluster has been estimated at 26 billion years, in serious conflict with the generally held view that the *universe* is only 7-10 billion years old.

why such ejections that occurred near the "beginning" have not yielded highly coiled systems; we are back to our original problem. It would seem more logical to believe that spiral galaxies are considerably younger than has been supposed.

(3) **Globular Clusters:** These are roughly spherical assemblages of stars that orbit around our galaxy as satellites. (see Figure 9) It is currently believed that such clusters are "very old" because they appear to be "highly evolved."

Some age estimates of globular clusters (e.g., M3 and M5) run as high as 26 billion years.[58] Obviously, the men who make such claims do not enjoy close fellowship with those who hold to a 7-billion-year-old universe. The more one studies the utterances of present-day astronomers the more one realizes how little concord exists. We are beset today with a hodgepodge of mutually contradictory ideas, brought about by a desire to superimpose an evolutionary framework on a degenerating universe.[59]

In the case of the M3 cluster an embarrassing situation has come to light. The problem, somewhat oversimplified, is this: If the cluster is as old as is claimed, why does it contain a number of "young" stars?[60] These relatively hot blue Main Sequence stars could not have existed for any great span of time, or their fuel would long since have been depleted.

As an explanation for this dilemma we are asked to believe that the blue stars condensed billions of years later than those in the rest of the cluster. But from what? The cosmogonist is woefully lacking in raw materials here, since globular clusters are notorious for their lack of interstellar material.

(4) **Binary Stars:** Pairs of stars that revolve about a mutual center of gravity are called binaries. It is now generally conceded that both members of such a pair were formed at the same time.[61] Yet one member of the pair is often a "young" star while the other is a "highly evolved" star.

Sirius, a nearby system, consists of two components: Sirius A, a bright blue Main Sequence

star; and Sirius B, a dim white dwarf. Sirius A is supposed to be a "young" star because fuel is being consumed at such a prodigious rate that it could not have been doing so for very long. Sirius B, on the other hand, has supposedly evolved through all the many stages leading to a white dwarf including T Tauri, Main Sequence, and red giant.

How can these things be? How can one star of a binary system appear young while the other appears old, yet both are acknowledged to be the same age? Theorists in the field seem satisfied with the explanation that Sirius B simply "evolved faster." With such a flexible theory one can play this game any way he pleases.

Like biological evolution it explains too much; any set of data can be rationalized to fit the theory by one means or another. A theory that is this insensitive to the observational data stands little chance of ever being overthrown.

Conclusions

1. There are many weak links in the hypothetical evolutionary life cycle of a star. The weakest of these is the alleged spontaneous birth of stars from interstellar material. Both scientific data and Scripture militate strongly against the doctrine of continuous star formation. This idea has undoubtedly come about as a consequence of the implicitly atheistic assumptions that underlie the majority of present-day astronomical speculations.

Observation and revealed truth both point to the creation of all stars at a definite time in the past *by processes totally dissimilar to present processes.* The present astronomical economy involves degeneration, dissipation, and "running down" in stars, whereas there must clearly have been an initial period of organization and "winding up."

2. The problem of how galaxies are supposed to structure themselves from primordial material is one of the most enigmatic questions in the whole realm of cosmogony. Few cosmogonists have been willing to undertake study of this problem. Those who have attempted it have failed disastrously.

The question of the inability of galaxies to maintain their structure over long periods of time is one that needs serious study by Christian men of science. This would appear to be a promising avenue of research for establishing a recent Creation.[62]

3. There is still no acceptable evolutionary explanation for the existence of planets. According to our present understanding, solid particles would fail to agglomerate to form even small chunks of material, let alone planets. That planets do form spontaneously is held today strictly as an article of evolutionary faith.

4. Astronomical dating methods appear to be entirely devoid of scientific value, since they involve guessing at an evolutionary history for the object being dated. The fact that astronomers disagree widely on such imagined histories accounts for the many serious age discrepancies in the literature today.

Age estimates are continually being inflated to keep step with the philosophical views of the times. Why, if cosmogonists are actually in possession of the truth at any given moment, must they change their theories and age estimates the next moment?

5. The evolutionary approach is utterly bankrupt when it comes to explaining the ultimate origin of anything. To the evolutionist, each stage of development requires a previous stage. Never can there be a true beginning. Yet scientific data and Scripture both demand such a beginning. The most satisfactory explanation for the origin of stars, galaxies, and planets is a rapid and miraculous Creation which endowed the heavens initially with all the diversity of structure and function that we observe today.

Acknowledgments

I am greatly indebted to Dr. Emmett Williams, fellow member of the Bob Jones University Science Department, whose thorough going knowledge of thermodynamics was most helpful on numerous occasions. Mr. Gary Guthrie of the Bob Jones University Mathematics Department was kind enough to provide a final check on my calculations, while Dr. Stewart Custer, Dr. Fred Afman, and Mr. Arend tenPas of our Bible faculty assisted in questions of interpretation of the Scripture portions cited; all three of these men concurred with the position set forth in this paper. Comments and suggestions by these five colleagues were greatly appreciated since there is such an appalling dearth of Christian literature on the subject.

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[1]Abell, G. 1969. Exploration of the universe. Second Edition. Holt, Rinehart, and Winston, N.Y., p. 572.

[2]Inglis, S. J. 1967. Planets, stars, and galaxies. Second Edition. John Wiley and Sons, Inc., N. Y., p. 325.

[3]Brandt, J. C. 1966. The sun and stars. McGraw-Hill Book Co., Inc., N. Y., p. 111.

[4]Quoted in Aller, L. H. and D. B. McLaughlin, 1965. Stellar structure. The University of Chicago Press, Chicago, Ill., p. 577. The statement was originally made in a lecture on star formation, *NUFFIC* International Summer Course in Science, 1960.

[5]Jastrow, R. and A. G. W. Cameron, editors. 1963. Origin of the solar system. Academic Press, N. Y., pp. 39-53.

[6]*Ibid,* p. 43.

[7]*Ibid,* p. 44. The mass of the cloud divided by its radius squared must be equal to 7.6 x 10^{-3} gm/cm^2. Using cgs units,

$$\frac{2 \times 10^{33}}{r^2} = 7.6 \times 10^{-3}$$

$$r^2 = \frac{2 \times 10^{33}}{7.6 \times 10^{-3}} = 2.63 \times 10^{35} cm^2$$

$$r = 5.13 \times 10^{17} cm \text{ or } 5.13 \times 10^{15} \text{ meters}$$

The volume of the cloud V_1 is $4/3\pi r^3$. Using MKS units, $V_1 = (4/3)\ (3.14)\ (5.13 \times 10^{15})^3 = 5.64 \times 10^{47}\ m^3$

[8]*Ibid,* p. 42.

[9]*Ibid,* p. 42. The sun's radius is 432,000 miles. One hundred times this value is 43,200,000 miles or 6.95 x 10^{10} meters. The volume of the condensed material V_2 is $4/3\pi r^3$. Using MKS units,

$$V_2 = 4/3\pi\ (6.95 \times 10^{10})^3 = 1.40 \times 10^{33} m^3$$

[10]The use of Cp rather than Cv is called for in this calculation since the volume is not constant.

[11]It can be shown that such a system should radiate away about half of its energy as it contracts. (See Smith, C. M. H. 1966. A textbook of nuclear physics. Student Edition. Pergamon Press, Oxford, p. 757.) If this energy were to remain in the cloud, its temperature would increase to 200,000°K rather than 100,000°K for T_2. Recalculating for this situation we still obtain about -30 eu/mole. Another objection that might be raised is that the initial cloud might be far larger and more massive, condensing into a cluster of stars rather than a single star. However, the same order of volume and temperature ratios would obtain, and our basic argument still stands.

[12]Page, T., and L. W. Page, editors. 1968. Stars and clouds of the Milky Way. The Macmillan Co., N. Y., pp. 246-253.

[13]Brandt, J. C. *Op. cit.,* p. 60.

[14]For the condensed material at 100,000°K, the force outward is 7.1 x 10^{28} newtons; the force inward is 8.2 x 10^{28} newtons. However, the outward force due to rotation has been ignored in this calculation.

[15]These equations may be combined to give

$$r = \frac{GM^2}{2nRT}$$

This is an expression for the radius at which the outward and inward forces are equal. It is not especially useful for our present purposes, however, because of the temperature uncertainty.

[16]Jastrow, R., and A. G. W. Cameron. *Op. cit.,* pp. 43, 44.

[17]Page, T., and L. W. Page. *Op. cit.,* p. 210.

[18]Mulfinger, G. 1967. Examining the cosmogonies—a historical review. *Creation Research Society Quarterly,* 4:57-69.

[19]Brandt, J. C. *Op. cit.,* p. 112

[20]*Ibid,* p. 112.

[21]Jastrow, R., and A. G. W. Cameron. *Op. cit.,* pp. 40, 43.

[22]*Ibid,* p. 41.

[23]*Ibid,* p. 42.

[24]Herbig, G. H. 1967. The youngest stars, *Scientific American,* August, pp. 30-36.

[25]Alfvén, H. 1966. Worlds-antiworlds. W. H. Freeman and Co., San Francisco, Calif. p. 77.

[26]*Ibid,* p. 78.

[27]Encyclopedia Brittanica. 1964. "Cosmogony." p. 580.

[28]The magnitude of the problem may be surmised from a recent issue of *Sky and Telescope.* On page 302 of the November, 1969 issue a model is described in which three cosmogonists started with 115,000 small gas clouds already arranged in a flat disc and already moving at the proper rotational speed! Is there no limit to how much contriving is considered legitimate?

[29]See Hodge, P. W. 1966. Galaxies and cosmology. McGraw-Hill Book Co., Inc., N. Y., pp. 6-14, 116, 117, for a good discussion of these early theories.

[30]*Ibid,* p. 123.

[31]Abell, G. *Op. cit.,* p. 629.

[32]Hodge, P. W. *Op. cit.,* p. 122.

[33]Jastrow, R., and A. G. W. Cameron. *Op. cit.,* p. 171.

[34]*Ibid,* p. 171, 172.

[35]*Ibid,* p. 172. This difficulty is discussed in Whitcomb, John C. 1964. The origin of the solar system. Presbyterian and Reformed Publishing Co., Nutley, N. J. p. 12. Also Whitcomb's paper in the September, 1967 *Creation Research Society Quarterly* lists nine obstacles with which the best theories of the solar system are unable to deal successfully.

[36]*Ibid,* p. 68.

[37]Low, F. J., and B. J. Smith. 1966. Infrared observations of a preplanetary system, *Nature,* 212:675, 676.

[38]Inglis, S. J. *Op. cit.,* (Reference #2), p. 275, 276.

[39]Herbig, G. *Op. cit.,* p. 35.

[40]Meadows, A. J. 1967. Stellar evolution. Pergamon Press, Oxford, p. 151.

[41]Aller, L. H. 1969. The planetary nebulae-part II, *Sky and Telescope,* 37:348.

[42]Inglis, S. J. *Op. cit.,* p. 298.

[43]Brandt, J. C. *Op. cit.* (Reference #3), p. 118.

[44]Abell, G. 1964. Exploration of the universe. First Edition. Holt, Rinehart, and Winston, N. Y., p. 532.

[45]In Gamow's The creation of the universe, 1952, (p. 32 in the Bantam Books Edition) he assured us that a former discrepancy had been rectified, and that the age of the universe had been securely established at 4.3 billion years. (Prior to that it had been 1.7 billion.) Yet in a later book he had increased the estimate to 5 billion. See Gamow, G. 1958. Matter, earth, and sky. Prentice-Hall, Inc., Englewood Cliffs, N. J., p. 518.

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[62]Another matter that should carefully be studied by Society members is the inability of comets to remain intact over long periods of time, and the implications of this fact on the date of Creation.