Advances in Social Sciences Research Journal – Vol.8, No.1
Publication Date: January 25, 2021
DOI:10.14738/assrj.81.9704.
Herndon, J. M. (2021). Nature of the Universe: Astrophysical Paradigm Shifts. Advances in Social Sciences Research Journal, 8 (1) 631-645.

Nature of the Universe: Astrophysical Paradigm Shifts

J. Marvin Herndon, Ph.D.
Transdyne Corporation
San Diego, California, USA

ABSTRACT

Over my lifetime I have witnessed the decline of scientific capability and integrity in the physical sciences. When a new idea arises, it should be discussed and debated. Attempts should be made to refute the new idea; otherwise, it should be cited in subsequent literature. That is the way science progresses, not by attempting to suppress a new idea or failing that, to ignore it. But all too often, in instances of discoveries or insights that might cause major paradigm shifts, suppression or non-recognition is what happens. Here, I describe, from a first-person perspective, several paradigm shifts in astrophysics that have been systematically ignored, including the thermonuclear ignition of stars, the nature of dark matter, why vast numbers of galaxies have just a few prominent patterns of luminous stars, the origin of chemical elements, and a new speculation about the nature of the Universe.

Keywords: Stellar ignition; Dark matter, Element synthesis; Cosmology; Dark galaxy; Spiral galaxy; Hubble; Universe.

INTRODUCTION

Throughout human history, scientific knowledge sometimes has been a source of enlightenment and other times, an excuse for persecution. Science is all about truth, truth securely anchored to the properties of matter and radiation. The science of our world today, however, has departed from standards of truth and objectivity, and has all too often become an arena for deceit by the science controllers. Yet truth is a fundamentally important human determinant, inextricably connected to the freedom we seek and deem precious.

The importance of the sun for human existence was recognized long ago in ancient cultures, and figured prominently in their religions and cosmologies [1-3]. Yet critical knowledge of our star, the sun, and the implications derived therefrom, although published in the scientific literature [4-6], has neither been shared nor disclosed by today's "scientists". But I share knowledge pertaining to the ignition of the sun which is crucial for progress along the path to better understand our Universe.

THE STARLIGHT PROBLEM

At the beginning of the 20th century, understanding the nature of the energy source that powers the sun and other stars was one of the most important unsolved problems in the physical sciences. Initially, it was thought that during formation, when dust and gas coalesce and collapse by gravitational attraction, great amounts of heat would be produced. But calculations showed that the energy release would be insufficient to power the sun for as long as life has existed on Earth. Following the discovery of radioactivity by Becquerel in 1896 [7], numerous experiments began to reveal the nature of radioactivity, the atomic nucleus, and nuclear reactions [8]. In 1934, Oliphant, Harteck, and Rutherford [9] discovered thermonuclear fusion reactions, an example of which is illustrated in Figure 1.

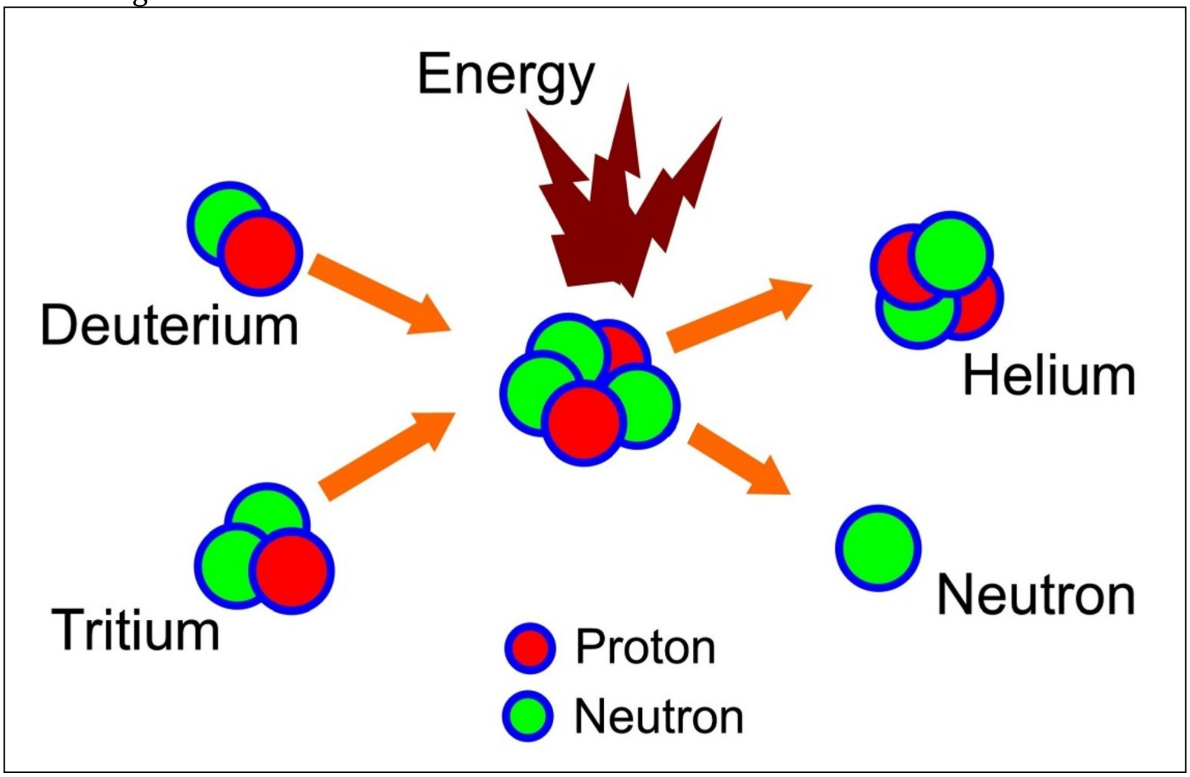

Figure 1. Schematic representation of a thermonuclear fusion reaction. The nuclei of light elements, deuterium and tritium, "fuse" to produce helium, a neutron, and a great amount of energy.

Thermonuclear fusion reactions are called thermonuclear because temperatures on the order of 1,000,000°C are required for the nuclei to achieve the very high velocities needed to overcome the electric charge repulsion and get close enough for the nuclei to react. When the fusion reaction takes place, a great quantity of energy is released.

Thermonuclear fusion reactions seemed to be the unknown source of energy that powers the sun and other stars, which contain copious amounts of hydrogen and helium. The scientific development of solar thermonuclear reactions was undertaken by nuclear physicists such as Edward Teller [10] and Hans Bethe [11], whose names would later be associated with the development of nuclear weapons.

By 1938, theoretical investigations on the thermonuclear reactions thought to power the sun and other stars had sufficiently progressed that there seemed to be no longer any question as to the sun's energy source. But as often happens in science, "*the devil is in the details*." In 1938, there was no energy source known that could produce the million degree temperatures necessary to ignite thermonuclear fusion reactions. So, it was just assumed that such temperatures would be produced during formation when dust and gas coalesce and collapse by gravitational attraction.

Scientists tend to be forward-looking, and rarely look questioningly at circumstances in the past that set them on their present path. That was certainly the case for igniting thermonuclear reactions in stars by gravitational collapse. In 1965, Hayashi and Nakano [12] first showed that gravitational collapse of dust and gas during formation would not yield the requisite million degree temperatures for igniting thermonuclear fusion reactions. The reason is obvious. Heating a forming star by the gravitational collapse of dust and gas is offset by heat radiated from its surface, which is a function of the fourth power of temperature. In other words, TxTxTxT represents a huge loss factor when T=1,000,000°C. But instead of asking "what is wrong with this picture", astrophysicists just made *ad hoc* assumptions, such as a shock-wave induced flare up, or they tweaked model-parameters in attempts to attain the requisite temperatures [13, 14].

The sun is like a hydrogen bomb held together by gravity (Figure 2). Both are powered by thermonuclear fusion reactions, and both require temperatures on the order of a million degrees Celcius for ignition.

Figure 2. The sun (left) is like an on-going hydrogen bomb (right) held together by gravity.

Both Teller and Bethe made crucial contributions to hydrogen bomb technology. But another critical discovery was made between the time of their work on thermonuclear reactions in the sun and on hydrogen bombs. That discovery, made in December 1938 and published in *Die Naturwissenschaften* in January 1939, was nuclear fission, the splitting of the uranium nucleus [15].

As experimental investigations early in the century revealed, nuclear reactions can be artificially induced by bombarding a target nucleus with neutrons. This may cause the target nucleus to become an entirely different element, changing its element number (proton number) by no more than two. In 1938, however, Hahn and Strassmann [15] bombarded uranium with neutrons, and chemically detected barium, an element about half the proton number of uranium. Hahn and Strassmann had split the uranium nucleus into two parts.

Splitting the uranium nucleus releases an enormous amount of energy and liberates neutrons. These newly released neutrons could split other uranium nuclei, which could split others, and so forth in a chain reaction that is the basis for the atomic (fission) bomb [16, 17] and nuclear reactors [18] (Figure 3).

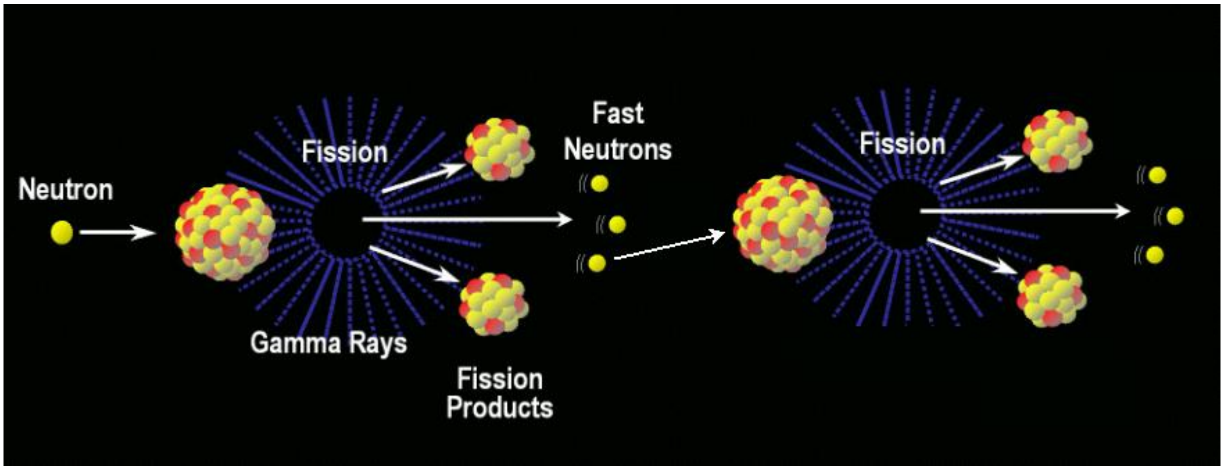

Figure 3. Schematic representation of the uranium nuclear fission chain reaction.

Nuclear fission, discovered as war clouds were gathering over Europe in December 1938, immediately became of paramount interest as a potential new weapon of war. That potentiality became a reality with the detonation of atomic (fission) bombs over Hiroshima and Nagasaki in 1945 [17]. Just seven years later, the United States detonated the first thermonuclear fusion bomb, also called hydrogen bomb, on Eniwetok Atoll in the Pacific Ocean [19]. That hydrogen bomb and all subsequent hydrogen bombs have utilized a nuclear fission chain reaction device to ignite their thermonuclear fusion reactions.

PLANETARY NUCLEAR FISSION REACTORS

Enrico Fermi formulated nuclear reactor theory [20] and in 1942 constructed the first man-made nuclear fission reactor at the University of Chicago. Producing a nuclear fission chain reaction from naturally occurring uranium required a clever reactor design because readily fissionable U-235 presently comprises only 0.7% of uranium.

In 1956, Paul Kazuo Kuroda applied Fermi's nuclear reactor theory and demonstrated that nuclear fission chain reactions could have occurred in seams of uranium ore two billion years ago when the relative proportion of U-235 was greater [21, 22]. Kuroda later told me that the idea was so unpopular that the only way he managed to get it published was because at the time the *Journal of Chemical Physics* would publish short papers without review. Even in 1956 peer-reviews were being used as a means to suppress publication of scientific advances!

In 1972, French scientists discovered, in a uranium mine at Oklo in the Republic of Gabon in Western Africa [23, 24], the intact remains of a natural nuclear reactor that had operated as predicted by Kuroda [21, 22] (Figure 4).

Figure 4. Seam of uranium ore in an Oklo natural nuclear reactor zone. Photo courtesy of Francoise Gauthier-Lafaye.

As astronomers first discovered in the late 1960s, three of the giant gaseous planets, Jupiter, Saturn, and Neptune radiate into space approximately twice the energy they receive from the sun and display prominent turbulence [25, 26] (Figure 5). The explanation proffered by NASA-funded scientists was that the energy is gravitational [27]. It did not make sense to me that Jupiter should still be collapsing after 4.5 billion years. Reflecting on the problem, I realized that Jupiter has all the ingredients for a planetocentric nuclear fission reactor. I applied Fermi's nuclear reactor theory to demonstrate the feasibility that the internal energy production and atmospheric turbulence in the giant planets is produced by planetocentric nuclear fission reactors. My scientific paper on the subject was published by *Naturwissenschaften* in 1992 [28].

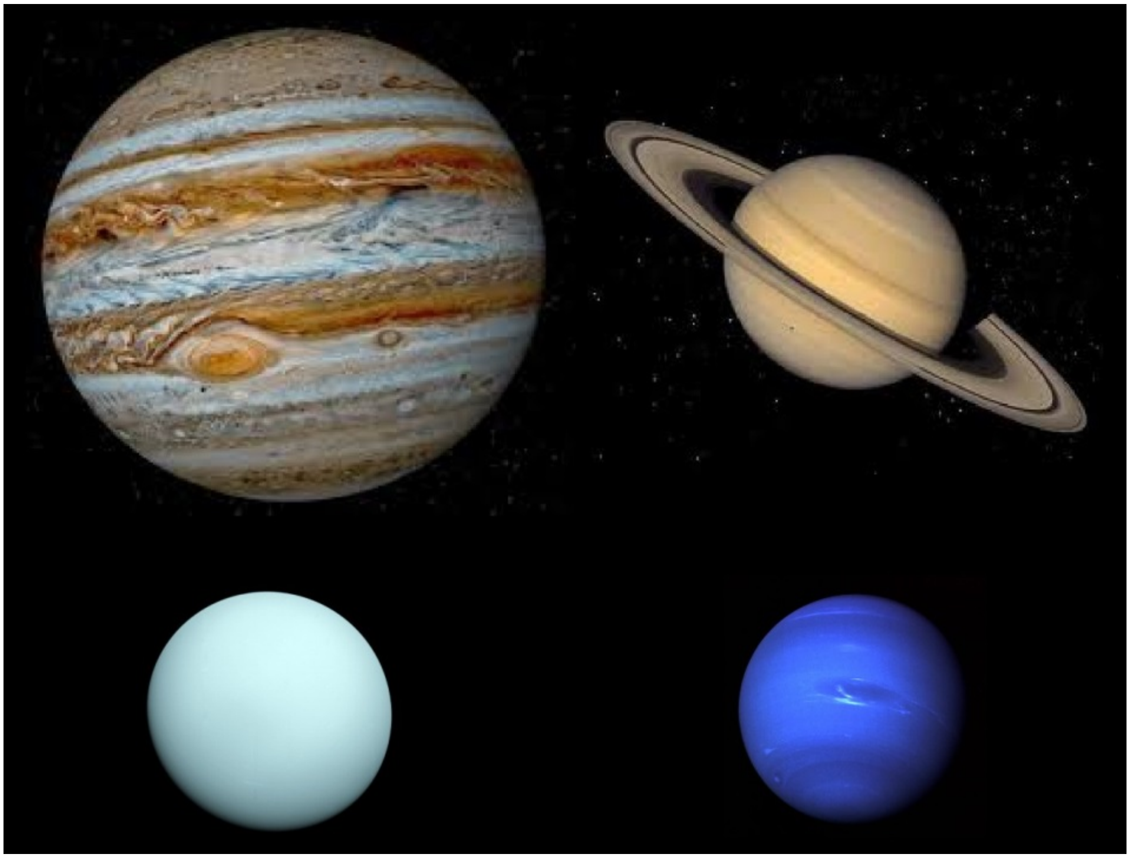

Figure 5. Turbulence in the atmospheres of Jupiter, Saturn, and Neptune, but not conspicuous in the atmosphere of Uranus, pictured in the lower left.

Initially, I thought that hydrogen would be necessary to slow neutrons for the nuclear fission chain reaction (Figure 3), but quickly realized that hydrogen was not at all necessary. That opened the possibility of central nuclear fission reactors inside other planets and large moons, such as Io, that could power and produce their magnetic fields [4, 28-36]. To my knowledge, over a period of 39 years, NASA-funded scientists have never cited my work on nuclear fission reactors inside planets and large moons, despite its being published in some of the world's foremost scientific journals [4, 28-37].

THERMONUCLEAR IGNITION OF THE SUN AND OTHER STARS

Shortly after publishing my demonstration of the feasibility of nuclear fission reactors for the giant planets [28], I started thinking about Jupiter being similar to, but much too small to have become a star. A star is like a hydrogen bomb held together by gravity, and all hydrogen bombs are ignited by their own small atomic (nuclear fission) devices. Is it possible that the thermonuclear reactions in stars are ignited by nuclear fission chain reactions? Could it be that the astrophysics community missed that? That seemed unlikely, especially as both Teller and Bethe had done pioneering work on thermonuclear reactions that power the sun, and both had worked on the development of hydrogen bombs. In fact, Edward Teller is known as the *father of the hydrogen bomb*.

Nevertheless, I headed for the science library and meticulously researched the literature. I found no mention of stellar thermonuclear ignition by nuclear fission in the scientific journals. And to be sure, I even hired a research librarian to search all available online data bases. That computer search still revealed no mention of stellar thermonuclear ignition by nuclear fission. Amazing! Teller and Bethe had neglected to look over their shoulders, neglected to reconsider their previous work in light of the lessons learned from their later work.

I promptly wrote a short scientific article about thermonuclear ignition of stars by nuclear fission chain reactions, which was rejected by several journals before being accepted for publication in the *Proceedings of the Royal Society of London* [4]. One of the rejections was based upon an anonymous reviewer's remark that "*Herndon is throwing away forty years of astrophysics*." So, what is wrong with that? Science progresses by finding what is wrong with current ideas and correcting them. Scientists would have welcomed my paradigm shift as it affords new insights and opens new possibilities for scientific discoveries [38].

NEW INSIGHT ON THE NATURE OF DARK MATTER

It has always been my experience that new insights and discoveries inevitably lead to further new insights and to further new discoveries. In the old, flawed paradigm, stars (except tiny brown dwarfs) are always thought to ignite by gravitational collapse during formation. In my new paradigm, however, stellar ignition requires the presence of very heavy elements, such as uranium or plutonium, to undergo nuclear fission chain reactions. Without fissionable heavy elements, after cooling from contraction, the stars would be dark stars. Without heat generated by thermonuclear reactions to expand their gas, a dark star the mass of the sun would have a diameter similar to that of Earth. One of the consequences of my new insight on star ignition is that it sheds light on the nature of dark matter [4].

A spiral galaxy, such as shown in Figure 6, represents a dynamically unstable assemblage of stars that would hypothetically wrap around its center of rotation, unless it is surrounded by a massive halo of unseen (dark) matter 10-100 times as massive as the luminous stars [39]. In Figure 6, this yet unobserved halo of dark matter is illustrated in green. I suggested that the dark matter surrounding luminous galaxies is composed of dark stars, the consequence of stellar non-ignition that results from the absence of fissionable elements. I even pointed out corroborating evidence, namely, the association of low-metal stars in the regions believed populated by dark matter [4].

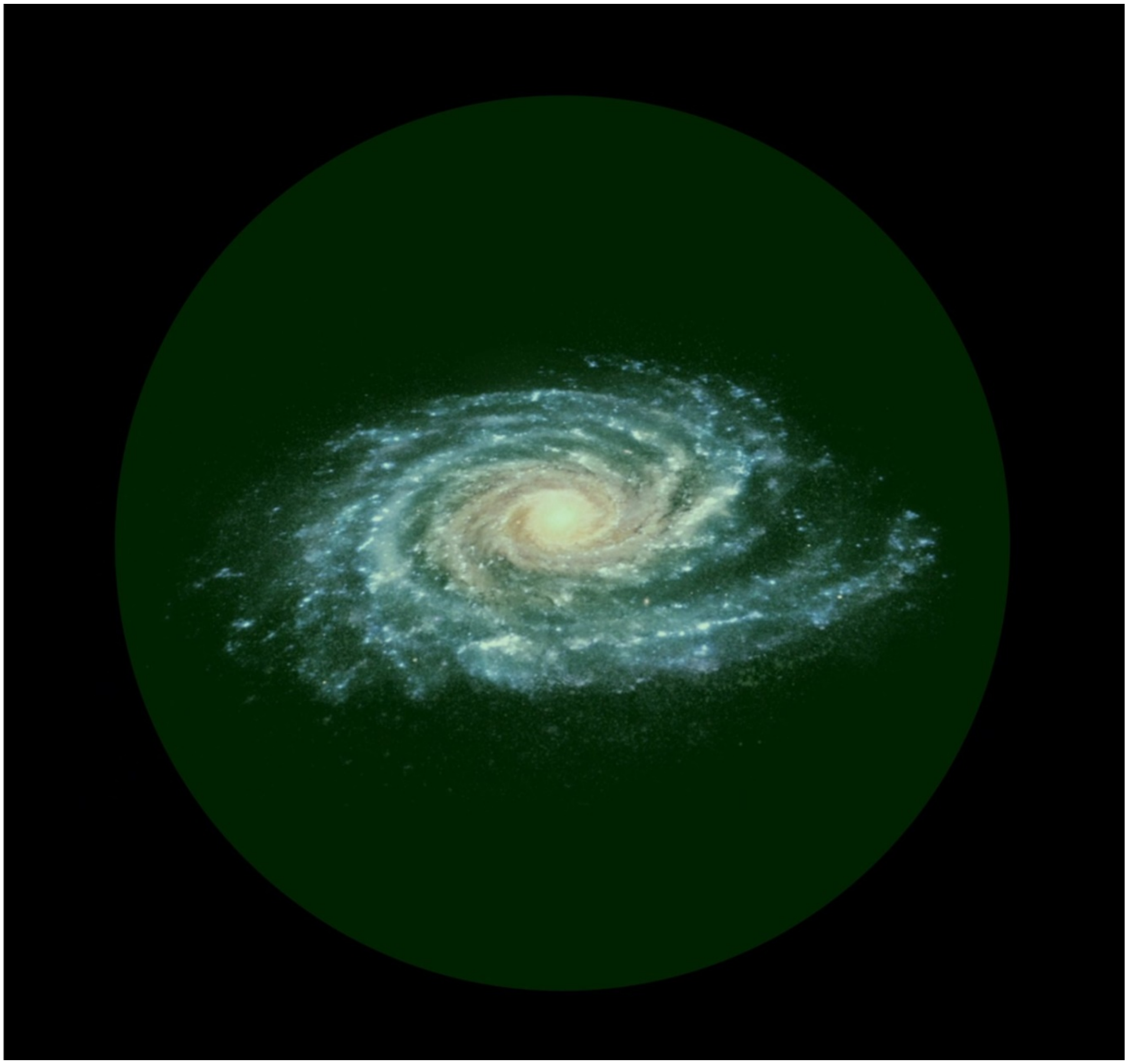

Figure 6. Typical spiral galaxy. The hypothetical green halo shows the region where dark matter is thought to reside, imparting dynamic stability to the luminous configuration of stars [39].

The question of what constitutes dark matter is a subject of active debate in the astrophysics community with a wide range of exotic possibilities discussed, such as hypothetical axions and putative primordial black holes [40]. To the best of my knowledge, in the intervening 27 years since publication of my concept of dark matter consisting of dark stars [4], no astrophysicist has cited my suggestion that zero-metallicity dark stars may account for at least a significant portion of the dark matter in the Universe.

THERMONUCLEAR IGNITION OF DARK GALAXIES

Figure 7 is a Hubble Space Telescope deep-field view showing approximately 15,000 galaxies. Two features stand out and beg for explanation. First, among this vast number of galaxies, there are only a few prominent morphologies, suggesting a commonality of formative conditions. Second, a vast proportion of the observable luminous galaxies are flat, not spherical.

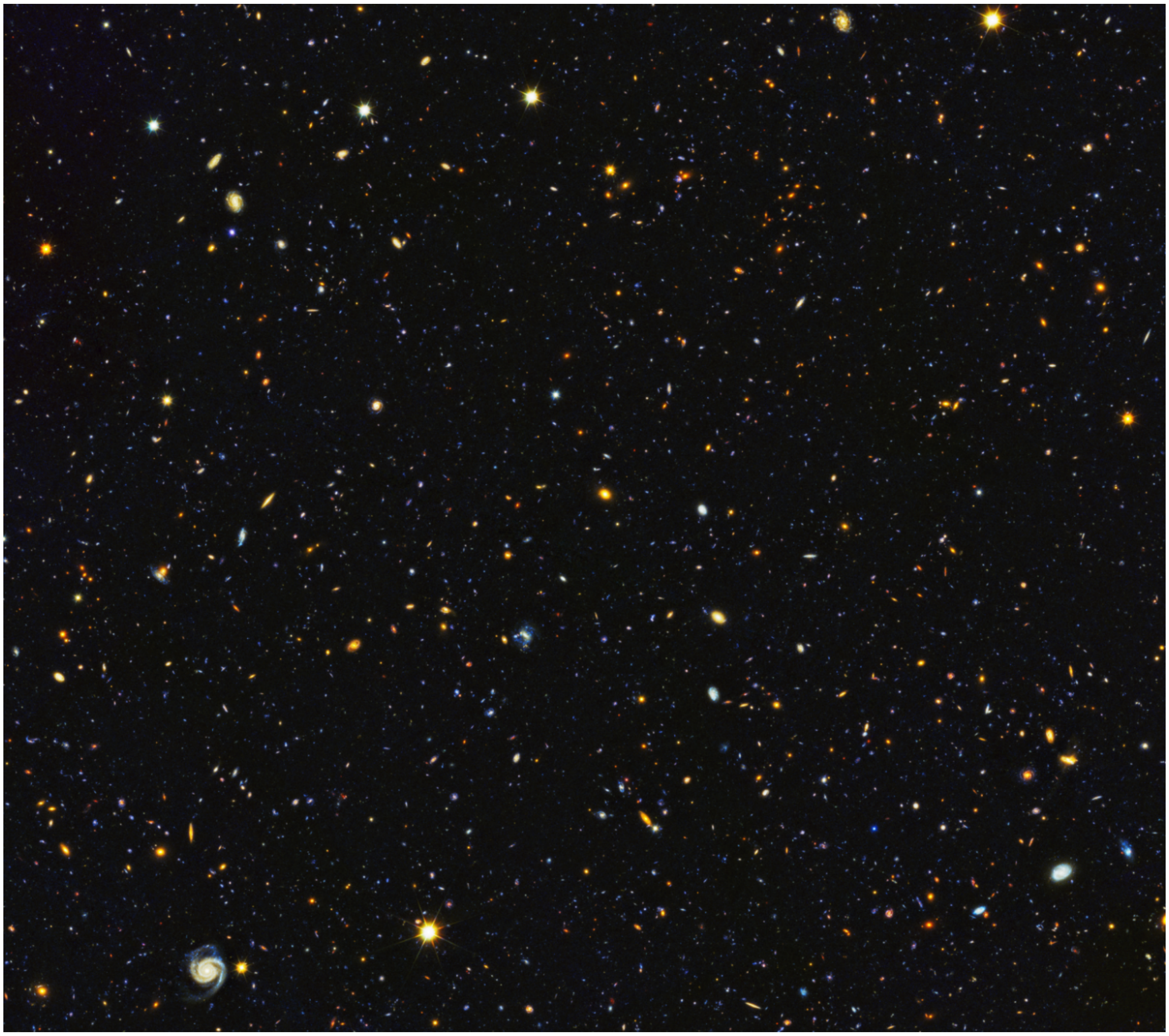

Figure 7. Hubble Space Telescope deep field photograph showing approximately 15,000 galaxies.

Astronomers have produced a wealth of observations about the matter in the Universe. Astrophysicists attempt to explain these observations, but they are crippled by scientific failings, for example, by making models based upon assumptions instead of making discoveries, by ignoring contradictory concepts, and by accepting without question obtuse ideas. I include among those obtuse ideas the concept that the Universe sprang into existence from a point of nothingness some 13.8 billion years ago, and that at the center of galaxies matter disappears forever into black holes.

From long experience I have learned that nature can usually be understood as operating in logical, causally related ways that do not require unscientific suppositions.

Galaxies are massive assemblages of matter, some containing as many as a billion luminous stars. As matter at the galactic center becomes extremely massive, it does not disappear forever into black-hole nothingness, but instead matter is jetted from the galactic center into space as mono-polar or bi-polar galactic jets (Figure 8).

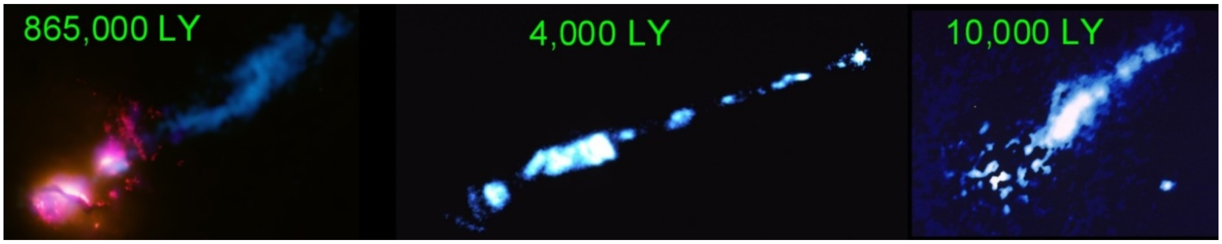

Figure 8. Hubble Space Telescope images of galactic jets with their lengths indicated in light years.

As I have published [4-6, 33, 41], the morphological features and galactic luminous star distributions can be understood in logical, causally related ways.

Consider a dark galaxy consisting solely of zero-metallicity dark stars, stars consisting only of hydrogen and helium. As the dark matter coalesces and becomes extremely dense at the galactic center, at some point the galactic center shoots out its first galactic jet. The galactic jet, I contend, seeds any of the dark stars it contacts with fissionable elements, capable of producing nuclear fission chain reactions, thus providing the million-degree temperatures necessary to ignite their stellar thermonuclear fusion reactions [5, 6].

What would a spherical dark galaxy look like after its first galactic jet? Figure 9a,b show two examples.

Figure 9a, NGC 4676, referred to as the *Mice Galaxies*, are two spiral galaxies. Note the "tail" of the galaxy on the right. This is a line of luminous stars that were ignited when that galaxy sent from its center its first galactic jet, which seeded the dark stars it encountered with fissionable elements that produced nuclear fission chain reactions that provided the million degree temperatures to ignite their thermonuclear fission reactions, thus turning the dark stars into luminous stars.

Figure 9b, UGC 10214, referred to as the *Tadpole Galaxy*, is a barred spiral galaxy in the early stage of luminosity when galactic jets sent from its center first begin to seed its dark stars with fissionable elements which, by nuclear fission chain reactions, ignite the dark stars encountered by the galactic jets.

Figures 9c,d show more evolved galactic luminous star distributions that nevertheless display the path of former galactic jets that provided the heavy-element component permitting stellar thermonuclear ignition. And what of the dark matter necessary for dynamical stability of the luminous structures? It is there in the un-ignited portion of the spherical dark galaxies.

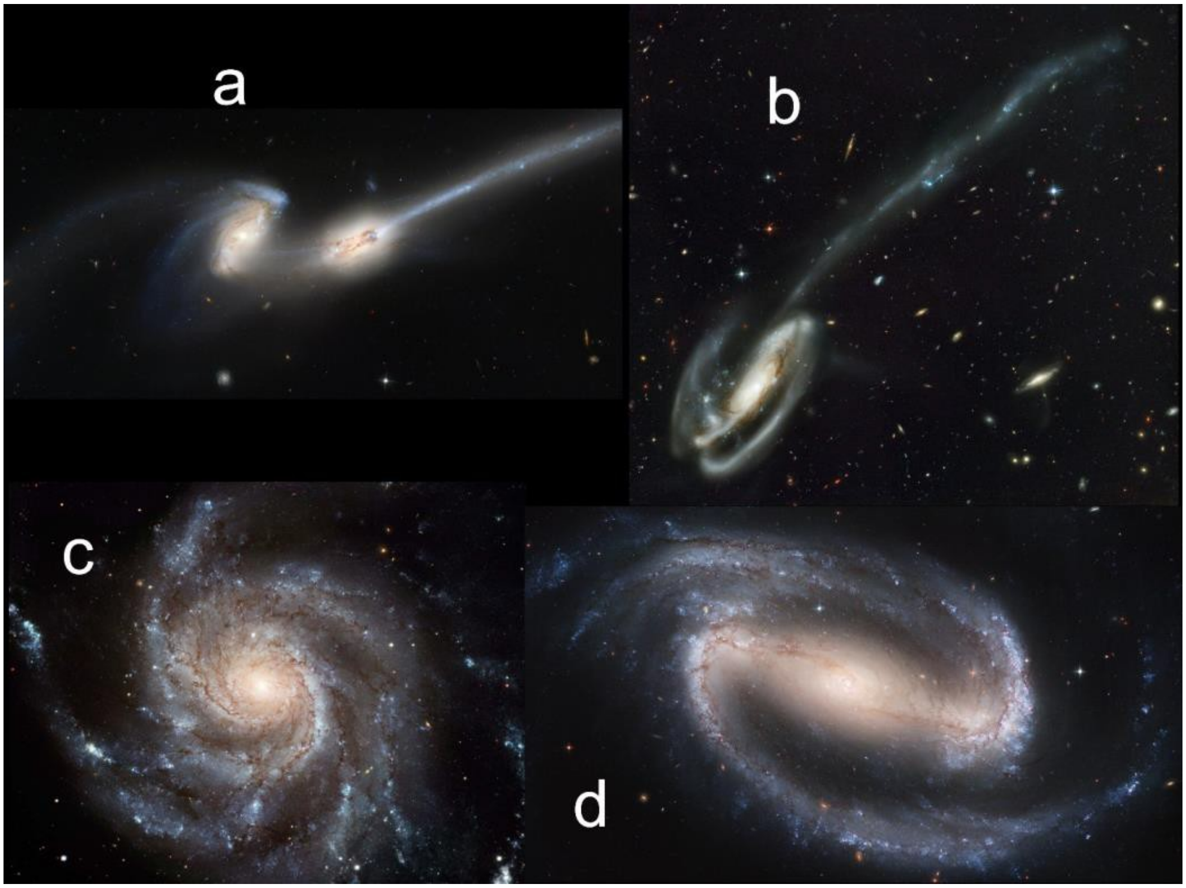

Figure 9. Hubble Space Telescope image of (a) NGC 4676, *Mice Galaxies*, (b) UGC 10214, *Tadpole Galaxy*, (c) spiral galaxy, M101, and (d) barred spiral galaxy, NGC 1300.

ORIGIN OF THE ELEMENTS

In a 1957 scientific article, entitled "Synthesis of the Elements in Stars," Burbidge, Burbidge, Fowler, and Hoyle [42] proposed that chemical elements are synthesized in stars by a number of processes. Heavy elements, however, were assumed to be solely produced by "rapid neutron capture" during supernova explosions. These ideas are still widely believed [43]. Subsequent observations [4], I posit, lead to a fundamentally different understanding of the origin of the elements [41], which I describe briefly here.

Astrophysicists group stars into two categories based upon their metal content. The association of low-metal stars in the region believed populated by zero-metal stars, i.e., dark stars [4], suggests to me that there exist two *primary* sources of chemical elements. One of the two *primary* sources consists solely of a mixture of hydrogen and helium (the stuff of zero-metallicity stars). The other *primary* source consists of the nuclear matter jetted out from the galactic center that yields not only the fissionable elements that ignite thermonuclear fusion reactions, but virtually all elements heavier than hydrogen and helium. *Secondarily*, over their lifetimes stars may synthesize some elements internally as well as possibly accumulating debris from previous astrophysical trauma-events.

SPECULATIONS ABOUT THE NATURE OF THE UNIVERSE

All attempts at this point in time to understand the nature of the Universe should properly be described as speculation, not science. But "*admirable speculation*," to use Galileo's words [44], is nevertheless an important part of science, as it represents an attempt to begin to understand a scientific unknown.

In 1929, Hubble [45] noticed that the more distant a galaxy, the more its spectrum of light is shifted toward the red. Hubble adopted the interpretation of Slipher [46] for galactic-spectrum-shifts as being Doppler shifts in frequency caused by radial velocity. To Hubble and to those who followed, essentially all of the galaxies are moving away from us, and the further they are from us, the faster that they are moving away. So, how can that be? If the interpretation of Doppler shift is correct, which I seriously doubt, then it must mean that the Universe is expanding. That interpretation is the underlying basis for the *big bang* theory that the Universe is expanding from a point of nothingness. Nonsense!

The implicit assumption underlying Hubble-expansion is that if there were no expansion, light would travel *forever* without changing frequency and wavelength. Many astronomers, going back to Johannes Kepler (1571-1630), have noted, in their own ways, that if the Universe is not expanding and is more-or-less homogeneous and is essentially *infinite* in size and has been in existence essentially *forever*, then the night sky should be filled with background light. But the night sky appears dark, simply lighted by points of light from stars and distant galaxies.

But behold! The sky is indeed filled with background light, but light not visible to the human eye. That light has lengthened in wavelength and is in fact the cosmic microwave background electromagnetic radiation discovered by Penzias and Wilson [47] (not a relic of the *big bang*, as some believe). Light, I posit, lengthens in wavelength on its long transit through interstellar space as it loses energy/mass through interaction with the *infinitesimal* matter along its sojourn, thus redistributing its energy/mass throughout a portion of the Universe, approaching cosmic equilibrium between its electromagnetic radiation and the *infinitesimal* matter.

Presumably, with much latitude for speculation, that *infinitesimal* matter becomes, through yet unknown reactions, hydrogen and helium, the primordial elements that in turn become the stuff of dark stars, which then gravitationally attract and form dark galaxies. As the galactic dark matter coalesces and becomes extremely dense at its center, at some point it begins to shoot out galactic jets. These jets, consisting of the parent nuclear matter for elements heavier than hydrogen and helium, seed dark stars they contact with fissionable elements and produce nuclear fission chain reactions, thus providing the million-degree temperatures necessary to ignite thermonuclear fusion reactions that light the formally dark stars. The now luminous stars radiate their visible light out into the Universe, beginning anew the redistribution of energy/matter in the Universe.
Thus the Universe has no obvious beginning, and no foreseeable end. Presumably, the Universe is finite, yet unbounded.

CONCLUSIONS

That the Universe has no obvious beginning, and no foreseeable end has both philosophical and theological implications. In the cosmology described here, the beginning, end, and age of the Universe are no longer ascertainable by scientific methodologies. In this instance, science no longer trumps theology.

Critical knowledge about the thermonuclear ignition of stars, and implications derived therefrom, although published in the scientific literature, have been un-cited and ignored by the scientific community. This is indicative of a bigger and far more devastating problem. Blatant deception and failure to tell the truth pervades officialdom worldwide and should not be tolerated, as these practices pose very real threats to civilization, and to individual freedom.

Recall these words: *And ye shall know the truth, and the truth shall make you free* (John 8:32).

References

1. Von Hagen, V.W., The ancient sun kingdoms of the Americas. Vol. 1. 2017: Pickle Partners Publishing.
2. Benson, E.P. and A.G. Cook, Ritual sacrifice in ancient Peru. 2001: University of Texas Press.
3. Breasted, J.H., Development of religion and thought in ancient Egypt. Vol. 45. 1972: University of Pennsylvania Press.
4. Herndon, J.M., Planetary and protostellar nuclear fission: Implications for planetary change, stellar ignition and dark matter. Proc. R. Soc. Lond, 1994. A455: p. 453-461.
5. Herndon, J.M., New concept for internal heat production in hot Jupiter exo-planets, thermonuclear ignition of dark galaxies, and the basis for galactic luminous star distributions. Curr. Sci., 2009. 96: p. 1453-1456.
6. Herndon, J.M., Inseparability of science history and discovery. Hist. Geo Space Sci., 2010. 1: p. 25-41.
7. Bacquerel, H., Sur les radiations emises par phosphorescence. Comptes Rendus, 1896. 122: p. 501-503.
8. Malley, M.C., Radioactivity: a history of a mysterious science. 2011: Oxford University Press.
9. Oliphant, M.L., P. Harteck, and E. Rutherford, Transmutation effects observed with heavy hydrogen. Nature, 1934. 133: p. 413.
10. Gamow, G. and E. Teller, The rate of selective thermonuclear reactions. Phys. Rev., 1938. 53: p. 608-609.
11. Bethe, H.A., Energy production in stars. Phys. Rev., 1939. 55(5): p. 434-456.
12. Hayashi, C. and T. Nakano, Thermal and dynamic properties of a protostar and its contraction to the stage of quasi-static equilibrium. Prog. theor. Physics, 1965. 35: p. 754-775.
13. Larson, R.B., Gravitational torques and star formation. Mon. Not. R. astr. Soc., 1984. 206: p. 197-207.
14. Stahler, S.W., et al., The early evolution of protostellar disks. Astrophys. J., 1994. 431: p. 341-358.
15. Hahn, O. and F. Strassmann, Uber den Nachweis und das Verhalten der bei der Bestrahlung des Urans mittels Neutronen entstehenden Erdalkalimetalle. Die Naturwissenschaften, 1939. 27: p. 11-15.
16. Serber, R., The Los Alamos primer: The first lectures on how to build an atomic bomb. 1992: Univ of California Press.
17. Rhodes, R., The Making of the Atomic Bomb. 1986, New York: Simon & Schuster.
18. Sekimoto, H., Nuclear reactor theory. 2008: COE-INES, Tokyo Institute of Technology.
19. Rhodes, R., Dark Sun: The Making of the Hydrogen Bomb. Vol. 2. 1996: Simon and Schuster.
20. Fermi, E., Elementary theory of the chain-reacting pile. Science, Wash., 1947. 105: p. 27-32.

21. Kuroda, P.K., On the nuclear physical stability of the uranium minerals. J. Chem. Phys., 1956. 25(4): p. 781-782.

22. Kuroda, P.K., On the infinite multiplication constant and the age of uranium minerals. J. Chem. Phys., 1956. 25(6): p. 1295-1296.

23. Frejacques, C., et al., in The Oklo Phenomenon. 1975, I.A.E.A.: Vienna. p. 509.

24. Hagemann, R., et al., in The Oklo Phenomenon. 1975, I.A.E.A.: Vienna. p. 415.

25. Conrath, B.J., et al., in Uranus, J.T. Bergstralh, E.D. Miner, and M.S. Mathews, Editors. 1991, University of Arizona Press: Tucson.

26. Hubbard, W.B., Interiors of the giant planets, in The New Solar System, J.K.B.a.A. Chaikin, Editor. 1990, Sky Publishing Corp.: Cambridge, MA. p. 134-135.

27. Stevenson, J.D., The outer planets and their satellites, in The Origin of the Solar System, S.F. Dermott, Editor. 1978, Wiley: New York. p. 395-431.

28. Herndon, J.M., Nuclear fission reactors as energy sources for the giant outer planets. Naturwissenschaften, 1992. 79: p. 7-14.

29. Herndon, J.M., Feasibility of a nuclear fission reactor at the center of the Earth as the energy source for the geomagnetic field. J. Geomag. Geoelectr., 1993. 45: p. 423-437.

30. Herndon, J.M., Sub-structure of the inner core of the earth. Proc. Nat. Acad. Sci. USA, 1996. 93: p. 646-648.

31. Herndon, J.M., Examining the overlooked implications of natural nuclear reactors. Eos, Trans. Am. Geophys. U., 1998. 79(38): p. 451,456.

32. Herndon, J.M., Nuclear georeactor origin of oceanic basalt 3He/4He, evidence, and implications. Proc. Nat. Acad. Sci. USA, 2003. 100(6): p. 3047-3050.

33. Herndon, J.M., Nuclear georeactor generation of the earth's geomagnetic field. Curr. Sci., 2007. 93(11): p. 1485-1487.

34. Herndon, J.M., Nature of planetary matter and magnetic field generation in the solar system. Curr. Sci., 2009. 96(8): p. 1033-1039.

35. Herndon, J.M., Terracentric nuclear fission georeactor: background, basis, feasibility, structure, evidence and geophysical implications. Curr. Sci., 2014. 106(4): p. 528-541.

36. Hollenbach, D.F. and J.M. Herndon, Deep-earth reactor: nuclear fission, helium, and the geomagnetic field. Proc. Nat. Acad. Sci. USA, 2001. 98(20): p. 11085-11090.

37. Herndon, J.M., NASA: Politics above Science. 2018: amazon.com.

38. Kuhn, T.S., The Structure of Scientific Revolutions. 1962, Chicago, IL, USA: University of Chicago Press.

39. Rubin, V.C., The rotation of spiral galaxies. Science, 1983. 220: p. 1339-1344.

40. Arun, K., S. Gudennavar, and C. Sivaram, Dark matter, dark energy, and alternate models: A review. Advances in Space Research, 2017. 60(1): p. 166-186.

41. Herndon, J.M., Herndon's Earth and the Dark Side of Science. 2014: Printed by CreareSpace; Available at Amazon.com and through other book sellers.

42. Burbidge, E.M., et al., Synthesis of the elements in stars. Rev. Mod. Phys., 1957. 29(4): p. 547-650.

43. Anders, E. and N. Grevesse, Abundances of the elements: Meteoritic and solar. Geochimica et Cosmochimica acta, 1989. 53(1): p. 197-214.

44. Drake, S., ed. Discoveries and Opinions of Galileo. 1956, Doubleday: New York. 301.

45. Hubble, E., A relation between distance and radial velocity among extra-galactic nebulae. Proc. Nat. Acad. Sci. USA, 1929. 15: p. 168-173.

46. Slipher, V.M., The radial velocity of the Andromeda Nebula. Lowell Observatory Bulletin, 1913. 2: p. 56-57.

47. Penzias, A.A. and R.W. Wilson, A measurement of excess antenna temperature at 4080 Mc/s. Astrophys. J., 1965. 142: p. 419-421.