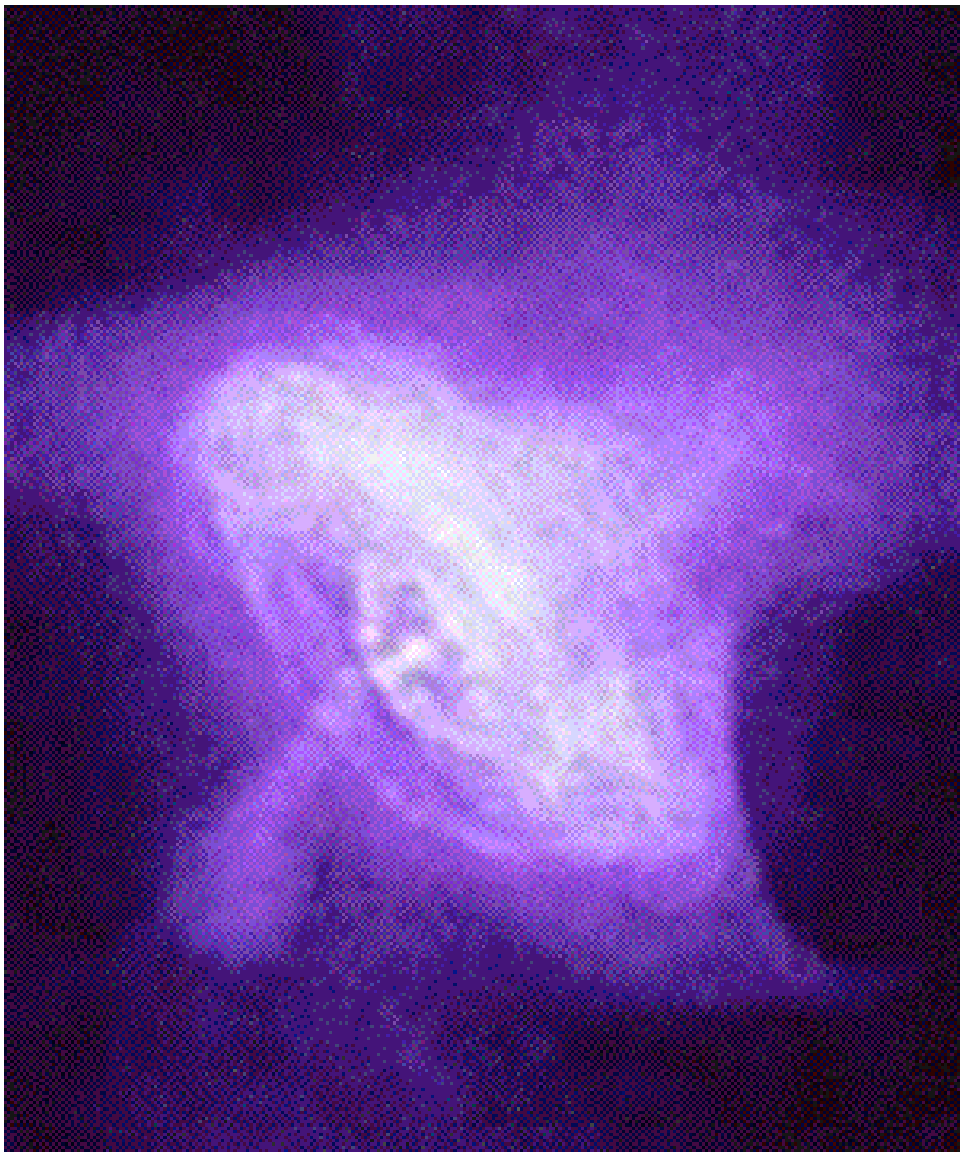
A Journey to the Core of the Sun

Chapter 2: Acceptance of Reality

*****The journey of life cannot be successfully traveled alone. The purpose of this book is to share **information hidden from the public in 1945**. This link shows photographs of a few who helped the journey succeed: http://www.omatumr.com/PhotoGallery.html



The Sun's pulsar core [1-3] birthed the solar system five billion years (5 Ga) ago [4], as the above pulsar birthed the Crab Nebula in 1054 AD. In 1945 ***FEAR convinced humans to hide NEUTRON REPULSION*** *[5] - the source of energy that causes cores of heavy atoms, some planets, stars and galaxies to violently fission and/or steadily emit neutrons that spontaneously decay to hydrogen (H) atoms. Rather than accept reality of the power that made our elements and then sustained the origin and evolution of life,* ***the scientific revolution that Copernicus started in 1543 ended quietly in 1945****.*

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

Nothing in life is to be feared,
It is only to be understood.
Now is the time to understand more,
So that we may fear less.
~ *Maria Skłodowska*-Curie

Chapter 2: Acceptance of Reality - The Solution

Cold weather, declining health, and a general concern for the survival and well-being of society catalyzed my decision to present ***clear and unequivocal evidence NEUTRON REPULSION is the source of energy that causes cores of heavy atoms, some planets, ordinary stars and galaxies to fission and/or to emit neutrons that spontaneously decay to hydrogen (H) atoms*, the *POWER*** Aston described in his Nobel Lecture as ***beyond the dreams of scientific fiction*** [1.14*].

All society deserves unambiguous evidence, especially the ninth grade teacher of Latin and algebra at Allison Junior High in Wichita, Kansas - **Eleanor O'Connell** - who tried to dissuade me from dropping out of school at the end of the 1951-52 school year; the science teacher who welcomed me back to North High in Wichita - **Cecil Gray** - in 1954-55 and made me his teaching assistant; the gifted physical chemist at Pittsburg State College, Dr. **Jim Pauley**, who guided my undergraduate studies and directed me to the University of Arkansas in 1959; Professor **Paul K. Kuroda** - assigned the graduate research project at the University of Arkansas that forced me to decipher hints in his [1.1] and Fred Hoyle's [6] autobiographies; and Professor **John H. Reynolds** - the UC-Berkeley physicist who developed the high-sensitivity mass spectrometer in 1956 that would be used in my career and then also allowed me to learn its operation in his laboratory in 1962 and 1964.

Kuroda perhaps realized that my obstinate perfectionism - ability to see flaws in others but not in myself - might equip me to confirm and communicate the fearful reality exposed by atomic bombs in 1945, and help society regain benefits reaped from the scientific revolution after accepting another fearful, ego-deflating part of scientific reality: Copernicus' 1543 discovery that ***Earth orbits the Sun !***

I first noticed flaws [7] in a graduate nuclear physics class in the spring semester of 1961: In the ***nuclear binding energy (B.E.)*** concept, and in ***omission of data*** points for the decays of the neutron and the tritium atom from Figure 2.1 in the

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

textbook, *The Atomic Nucleus* [8], by a MIT professor of physics, Dr. Robley D. Evans. Kuroda's comment [1.1, page 7] - about a physicist not grasping Aston's ***"packing fraction"*** - would later point to the hidden information [5].

To maintain focus on the central theme of this chapter, these flaws will be not be discussed here, except to point out that reliable information on nuclear energy and nuclear stability are *correctly represented by Aston's "packing fraction,"* based on precise measurements of the mass of each atom [9], but ***not*** *by values calculated for von Weizsäcker's "nuclear binding energy per nucleon (B.E./A)."* Replacing Aston's ***"packing fraction"*** with ***"nuclear binding energy per nucleon (B.E./A)"*** in textbooks [e.g., 10-11] after 1945 obscured neutron repulsion [5].

Values of *"nuclear binding energy"* are systematically high in neutron-rich atoms. For example the most stable known atom is correctly identified as ^{56}Fe by Aston's *"packing fraction,"* but the nuclear binding energy per nucleon (B.E./A) is greater for the more neutron-rich isotope, ^{62}Ni, than for ^{56}Fe. The *nuclear binding energy (B.E.)* of radioactive tritium (^{3}H) exceeds that of its stable decay-product (^{3}He); the *nuclear binding energy* of radioactive ^{14}C is greater than that of its stable decay-product (^{14}N), etc., across the entire spectrum of 3,000 different types of atoms.

Approaching the end of life, aware that society is deeply troubled, perhaps on the verge of collapse worldwide, this chapter's goal is to identify the ***"elephant in the living room"*** - the key to Aston's promise of ***"power beyond the dreams of scientific fiction"*** [1.14*]. To decide the validity of my conclusions, each reader must *actively* compare the conclusion on page 16 with consensus opinions published in textbooks of science after the end of World War II. ***The easier, softer way*** *is the path that led us to our current state of* ***servitude***, ***desperation*** *and* ***misery***.

The incredible power Aston acknowledged in his 1922 Nobel lecture on *"packing fractions"* [1.14] - the source of energy [4] that powers atomic bombs, the Sun and sustains our lives - is powerful but subtle: *Neutron repulsion (N.R.)* was concealed by Weizsäcker's deceptively convincing model of *"nuclear binding energy (B.E.)."*

The remainder of this brief chapter will present ***clear and unequivocal evidence*** **:**

1. Neutron repulsion is the source of energy in cores of heavy atoms and stars
2. The Sun made our elements, birthed the solar system and sustains our lives
3. Iron-56 is the most abundant and most stable atom in the Earth and the Sun

This conclusion to my career is published as written, not for royalties, but to help you access reality. To benefit from the reality illustrated on page 16, tell me** if you find flaws in evidence of a pulsar-centered Sun but ask other scientists if they have a better explanation for the experimental data shown in Figures 1-3.

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

1. Experimental

1.1 Proof of Neutron Repulsion

Figure 1 (below) shows convincing evidence of neutron repulsion [12-14] in cores of neutron-rich atoms (left), proton repulsion in cores of proton-rich atoms (right), and neutron-proton attraction in the middle. The vertical scale on this figure is the mass (energy) per nucleon, $\mathbf{M/A} = \boldsymbol{f} + \mathbf{1}$, where $\boldsymbol{f}$ is Aston's *"packing fraction."*

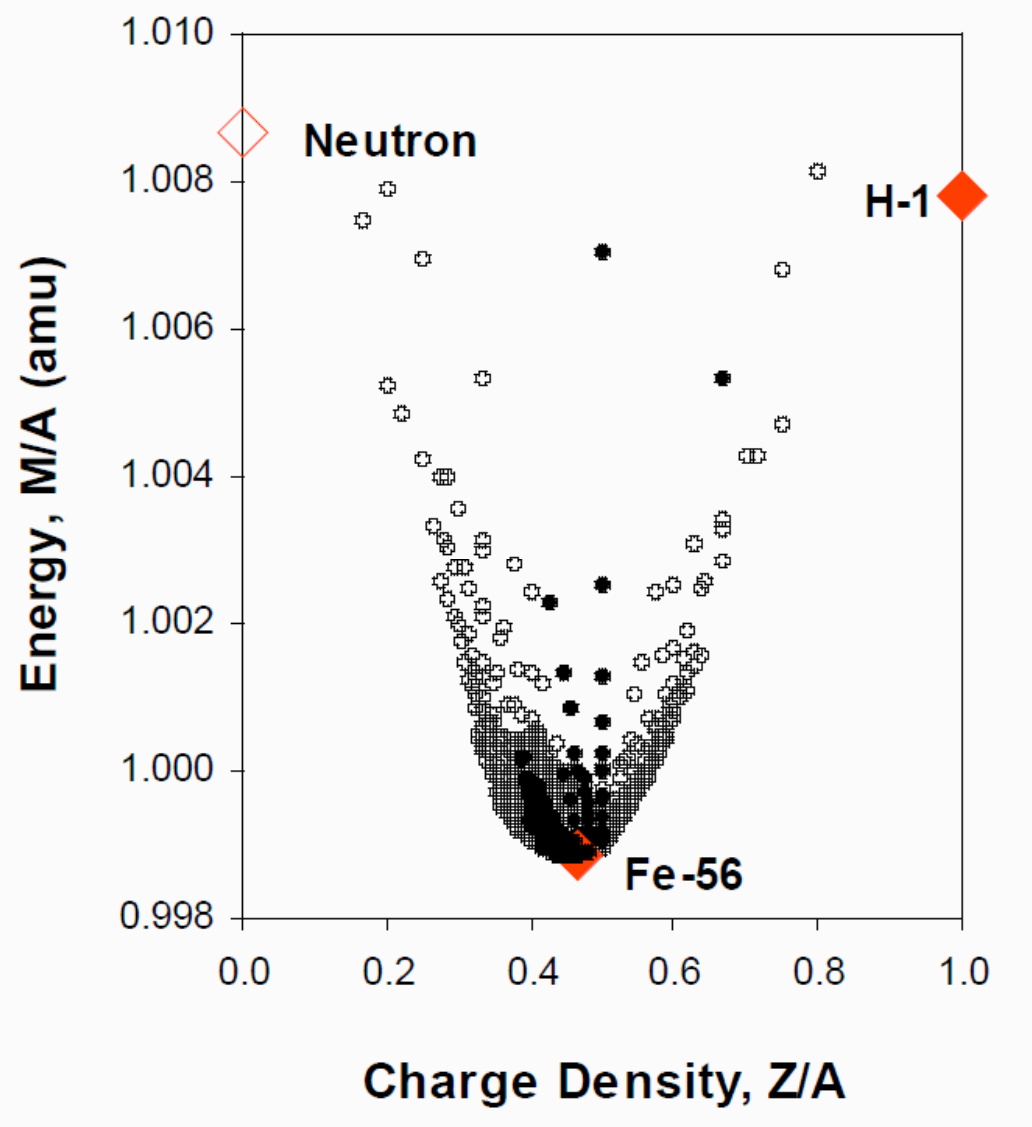


Figure 1a: Two forms of one fundamental particle shown by the **red** symbols on the left (**neutrons**) and right (hydrogen atoms, **H-1**) comprise every atom. The most stable atom, **Fe-56**, is also the most abundant atom in the Earth, in the Sun and in ordinary meteorites. On Earth H-1 is more stable than the neutron. At high pressure, H-1 atoms collapse into neutrons [15] and can be energized by N.R. to energy levels above the top of the page [5].

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

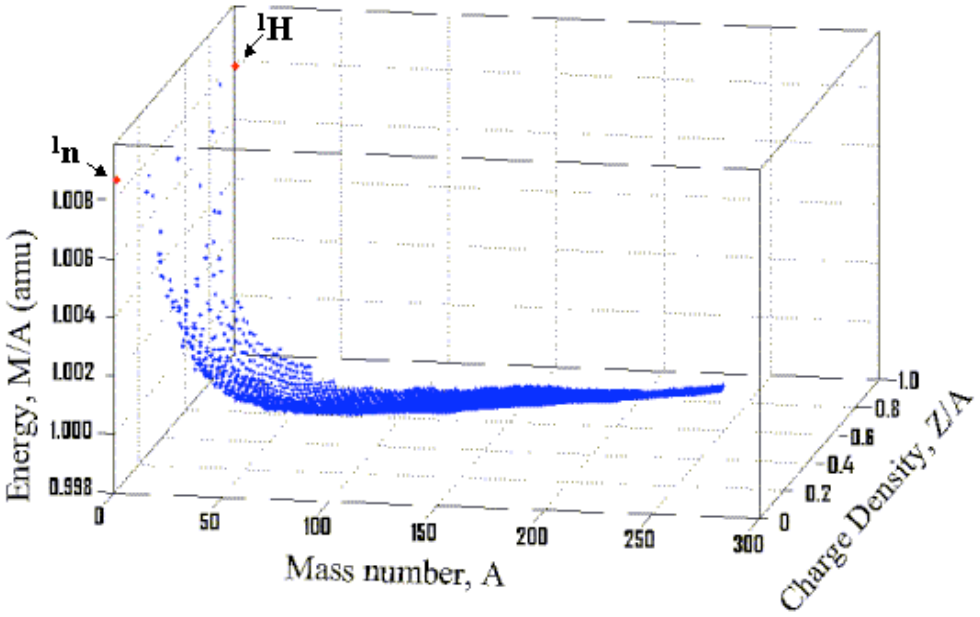


Figure 1b. Combinations of the two forms of one particle that comprise all of the atoms, neutrons (^{1}**n**) in the front and hydrogen atoms (^{1}**H**) in the back, are sorted above by mass number (A) on the horizontal axis and by charge density (Z/A) in the third dimension.

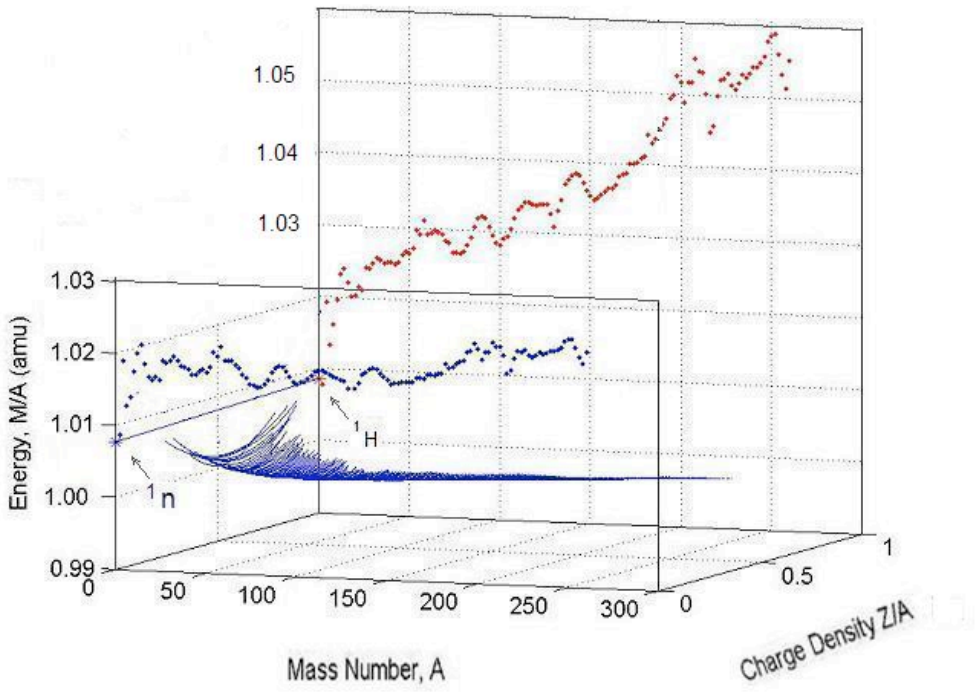


Figure 1c. Parabolas defined by mass data points reveal neutron repulsion at Z/A = 0 (**o**) on the front panel (nuclei made of neutrons only), proton repulsion at Z/A = 1.0 (**o**) on a back panel (nuclei made of protons only), and differences from Coulomb repulsion [12].

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

1.2 Proof of Local Element Synthesis

Figure 2 (below) shows evidence the solar system's elements were produced here and then formed solids before isotopes and elements from different regions of the supernova completely mixed. Figures 2a,b,c,d,e,f are all from papers published in 1972 [16], 1975/77/79/80 [17/18/19/20], 1993 [21], 1994 [4] and 1997 [22].

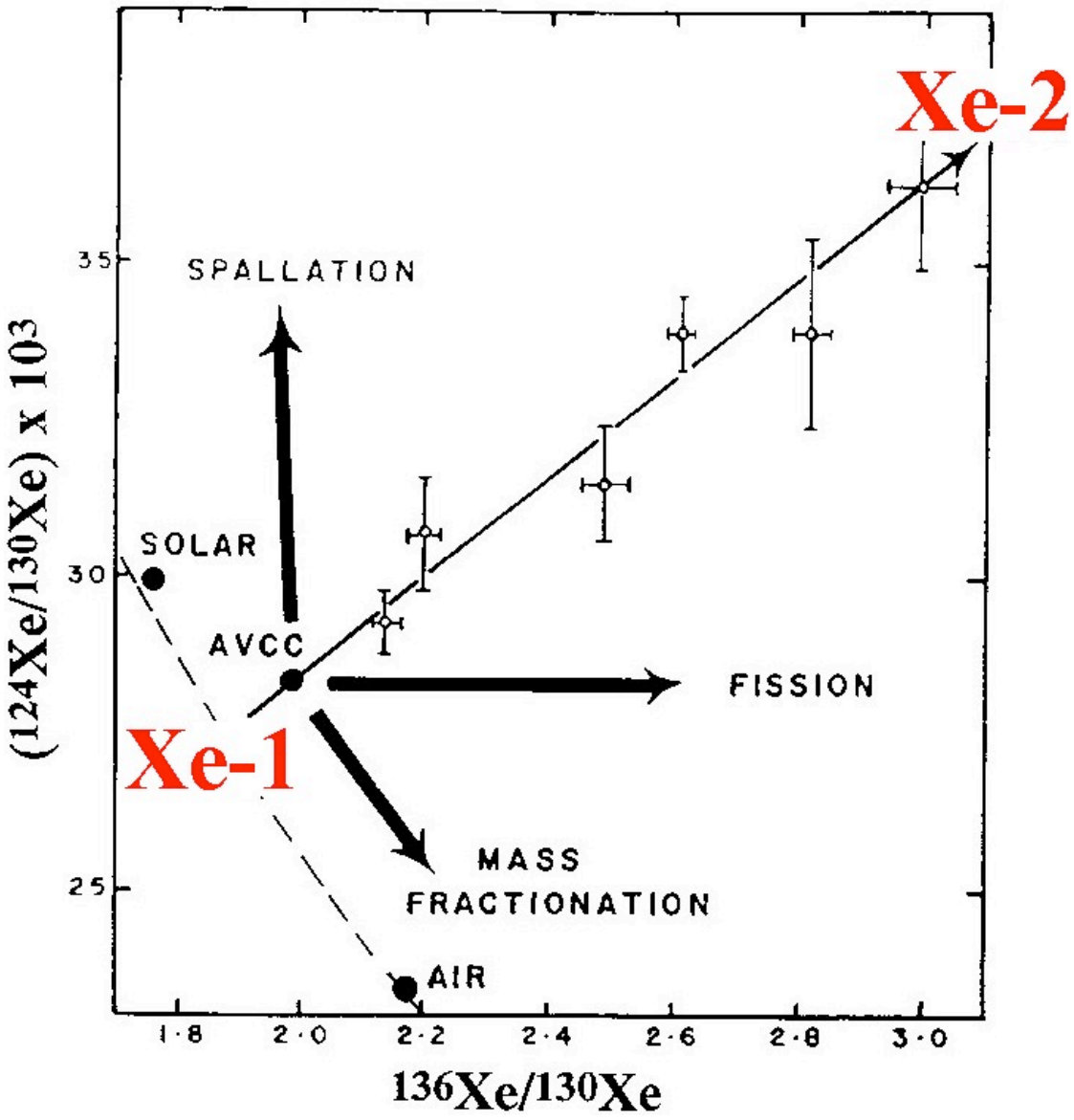


Figure 2a: "Normal" xenon, **Xe-1**, is dominant in the iron-rich, inner region of the solar system but mass fractionated (dashed line) in the Sun. "Strange" xenon, **Xe-2**, dominates the outer region of the solar system [23]. **Xe-1** is dominant in the Earth (**AIR**), the Sun (**SOLAR**), and in ordinary meteorites. At about 1000° C [16], carbon-rich inclusions of average carbonaceous chondrites (**AVCC**) selectively released **Xe-2** that is enriched in ^{124}Xe from the p-process and in ^{136}Xe from the r-process of nucleosynthesis [24].

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

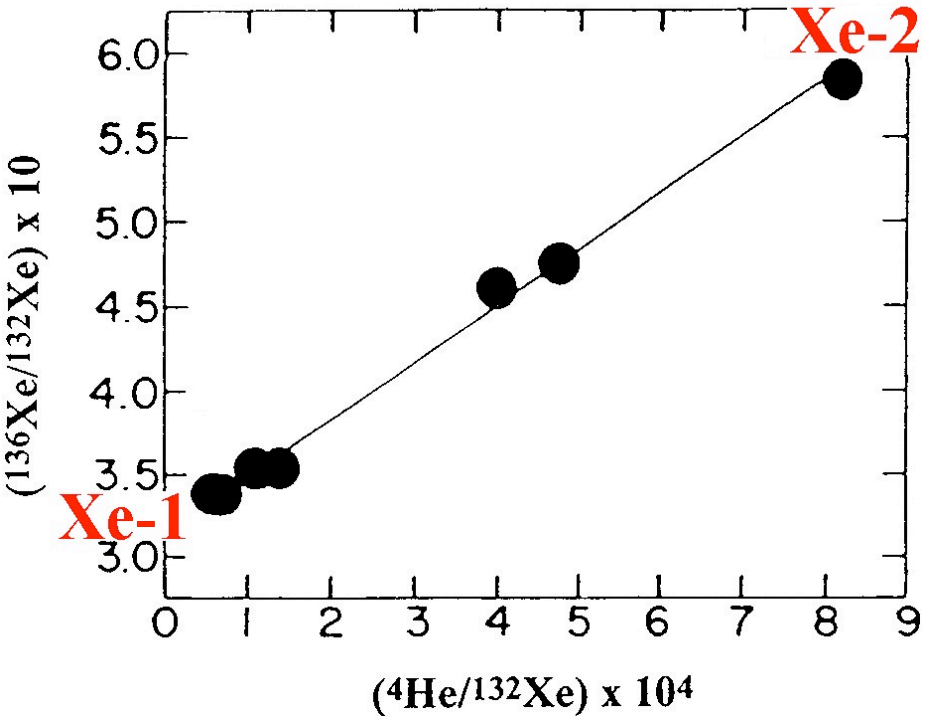


Figure 2b: Primordial helium (^{4}He) accompanies only "strange" xenon, **Xe-2**, in carbon-rich (diamond/graphite) mineral separates of the Allende [25] and other meteorites [20]. The Galileo probe later found "strange" xenon in Jupiter's He-rich atmosphere [23].

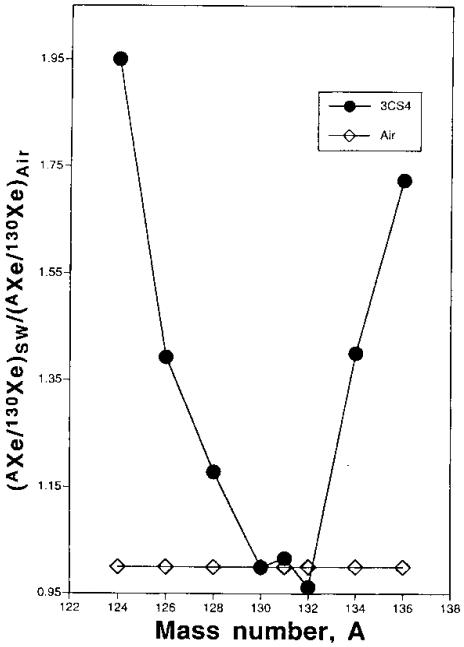


Figure 2c: "Strange" xenon, **Xe-2**, in Allende has excess light and heavy isotopes [25] from p- and r-processes of supernova nucleosynthesis [24]. "Strange" tellurium and its "complementary" component were also reported in Allende in 1979 [19].

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

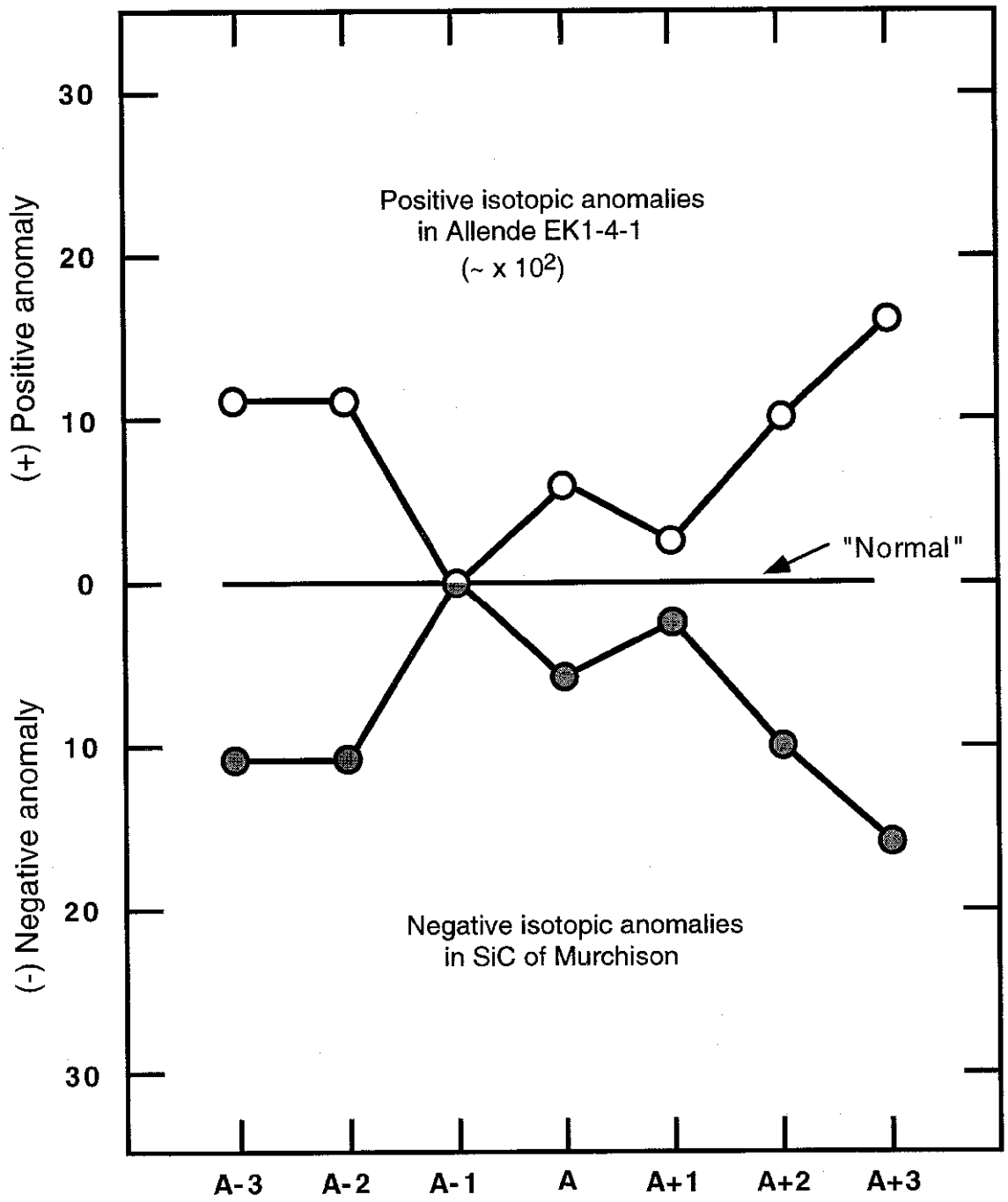


Figure 2d: In 1978 Srinivasan and Anders [26] found a "complementary" component to "strange" xenon, enriched in middle isotopes by the s-process of nucleosynthesis [24], in the Murchison meteorites. By 1993, "strange" and "complementary" isotopic anomalies had been found in the isotopes of xenon (element #54) [16, 26], tellurium (element #52) [19], barium (element #56), neodymium (element #60) and samarium (element #62) [21]. These two anomaly patterns are usually observed in refractory grains of diamond (C) and silicon carbide (SiC) that condensed early in the heterogeneous solar nebula [5].

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

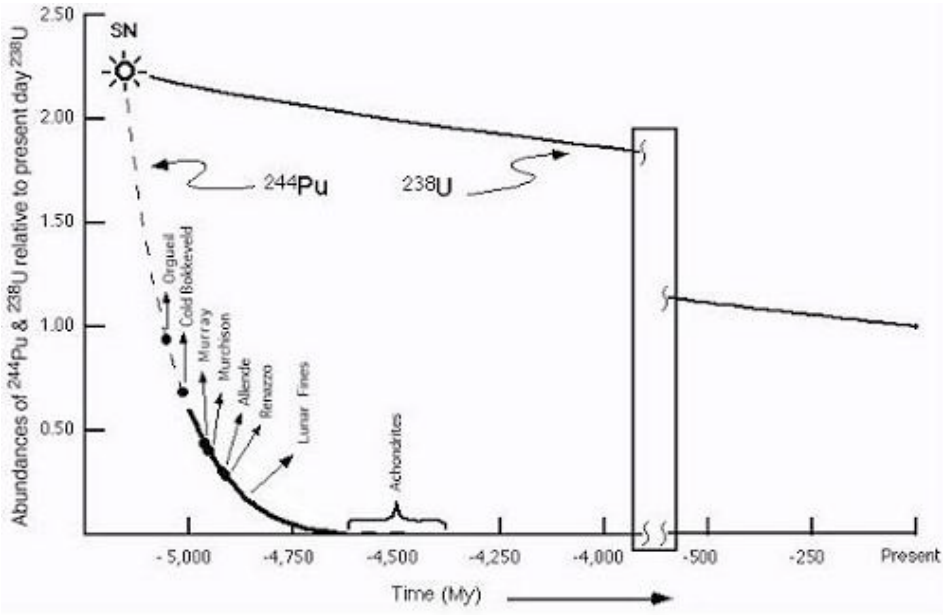


Figure 2e: Combined U/Pb and Pu/Xe age dating of primitive meteorites by Kuroda and Myers [4] show that the supernova exploded shortly before the oldest meteorites formed about five billion years (5 Ga or 5,000 My) ago.

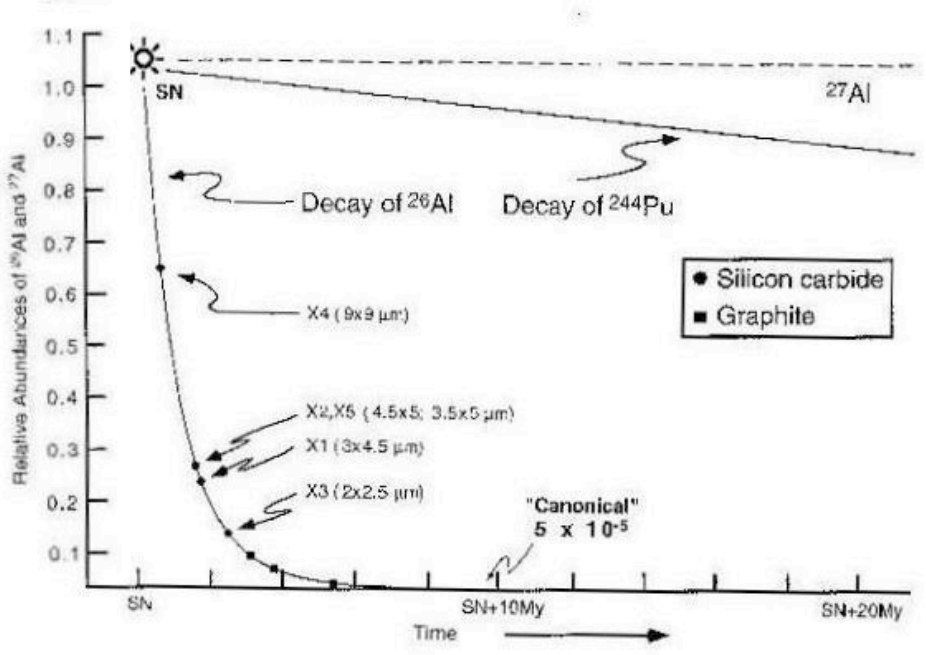


Figure 2f: $^{26}Al/^{26}Mg$ age dating of refractory meteorite inclusions of silicon carbide and graphite show that they formed within 1-10 My of the supernova with physical properties like those of "fall-out" particles from nuclear explosions [22]. The grains that formed first grew larger and trapped higher levels of radioactive ^{26}Al ($\mathbf{t}_{1/2}$ = 740,000 yr or 0.74 My).

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

1.3 Proof of the Iron-Rich Sun

Figure 3 (below) shows the results of *a few* of the thousands of measurements that revealed *unequivocal evidence* of solar mass-fractionation and the Sun's iron-rich interior. This ubiquitous evidence is even in publications of leading astronomers and astrophysicists. E.g., Sir Fred Hoyle exposed in his 1994 autobiography [6] an abrupt, inexplicable change in popular opinions on the internal composition and source of energy in the stars in 1946; Nobel Laureate William Fowler admitted in 1998 [27] that ***"we certainly do not understand the nuclear astrophysics which produced the oxygen and carbon in our bodies."*** Data from a well-known paper co-authored by these scientists, B2FH [24], are shown on the right in **Figure 3a**:

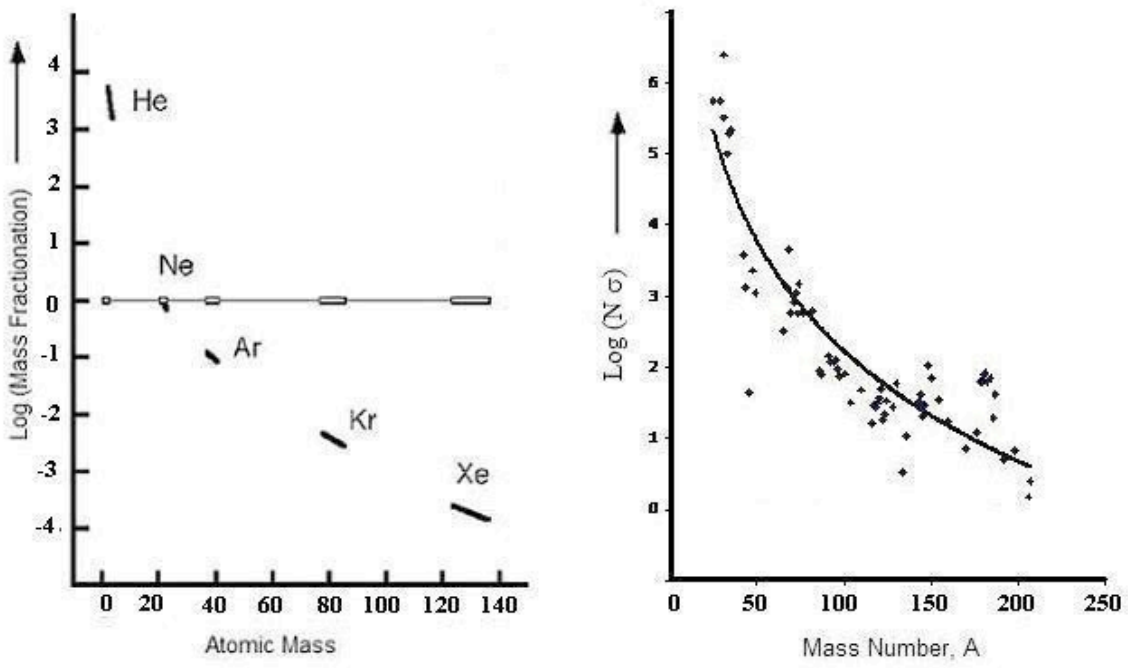


Figure 3a: Severe mass-fractionation in the Sun is obvious in the abundances of seventy-two (72) *s*-products in the photosphere (graph on the **right**) relative to the constant value of Nσ that B2FH predicted for s-products [24]. Theses s-products span a mass range of 25-207 amu. This is based on values reported by B2FH [24] for neutron-capture cross-sections (σ). The graph (**right**) is from a paper in the 2005 Lunar and Planetary Science Conference [28]. Severe mass-fractionation of noble gas isotopes in the solar wind (**left**) was noted in 1983 [29]. Precise measurements of noble gas isotopes implanted in lunar soils and breccias from the solar wind [30] (filled bars) are mass fractionated relative to those in planetary noble gases [31-33] (open bars). Solar mass fractionation of isotopes is shown in the graph on the **left** across 22 isotopes, spanning a mass range of 3-136 amu, and solar mass fractionation of s-products is shown in the graph on the **right** across 72 s-products spanning a mass range of 25-207 amu.

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

A common mass-fractionation of xenon and neon isotopes had been identified in 1970 [34] in the Sun and meteorites. The dashed line in **Figure 2a** identifies the mass fractionated xenon isotopes observed in primitive meteorites in 1972 [16]. It only became possible to identify a common mass fractionation across all the Sun's noble gas isotopes (See the graph of the **left** side of **Figure 3a**) after the discovery [25] in 1975 of "strange" isotope abundances in all three heavy noble gases, argon, krypton and xenon, was followed by the 1976 [35] finding that noble gases in the Sun are a mixture of "strange" ones, from the outer region of solar system, with "normal" ones from the inner regions of the solar system [36].

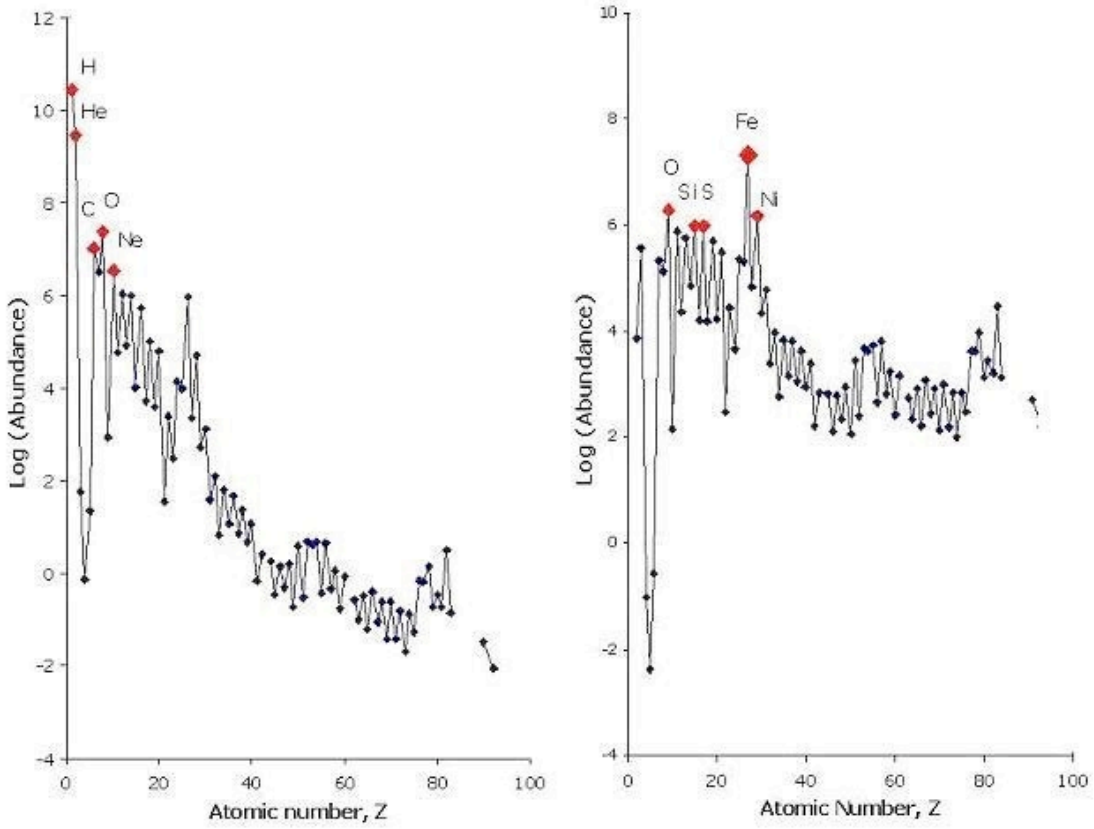


Figure 3b: The severely mass fractionated abundance pattern of elements at the top of the Sun [37] (**left**) becomes remarkably like the abundance pattern of elements on Earth and in ordinary meteorites [38] (**right**) - consisting mostly of Fe, O, Ni, Si and S - after correcting for the severe solar mass fractionation revealed by precise measurements [30] at the Universität Bern, Physikalisches Institut of isotopes implanted in lunar soil #bb18. Correcting for mass fractionation (**Figure 3a, right**) across the 72 s-products that B2FH [24] reported in the solar photosphere in 1957, yields the same five elements - Fe, O, Ni, Si and S - as dominant in the interior of the Sun that wet chemical revealed forty years earlier as the five most abundant elements in ordinary meteorites [38].

*References in earlier chapters are cited by [Chapter number.Reference number].
**1-573-647-1377 or omatumr2@gmail/com

There is thus abundant evidence the Sun's internal composition is ***not*** represented by light-weight elements (hydrogen and helium) at the top of its atmosphere, just as Earth's internal composition is ***not*** represented by gaseous nitrogen and oxygen in the air. Evidence of solar mass fractionation was noticed in the first meteorite I analyzed [39], the meteorite that fell near the University of Arkansas in 1934 [40].

http://www.omatumr.com/Photographs/Pics/Fayetteville.jpg

This finding was subsequently confirmed by numerous analyses of meteorites and material ejected from the Sun [41], but obscured by claims neon in meteorites is a mix of alphabetically labeled components of primordial neon: Ne-A, -B, -C [42].

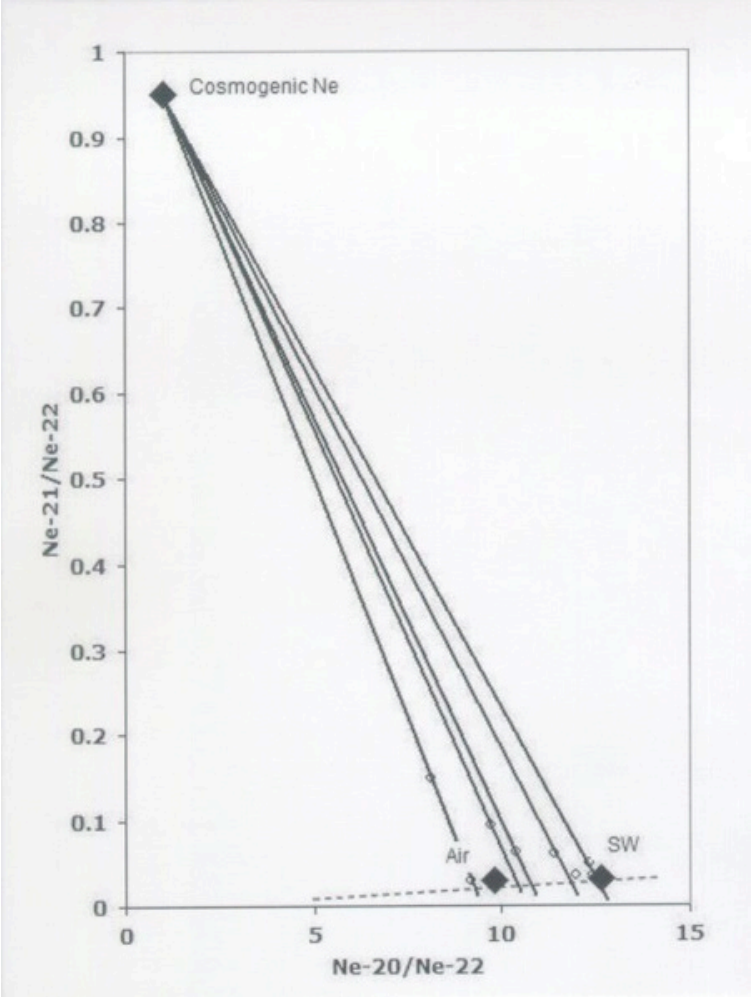


Figure 3c: Analysis of neon isotopes in the dark section of the Fayetteville meteorite in 1964 revealed a.) Neon isotopes in the upper left corner of the graph generated by cosmic ray bombardment (**Cosmogenic Ne**); b.) Neon isotopes implanted from the solar wind (**SW**) in the lower right part of the graph; and c.) Mass-fractionated forms of SW neon along the dashed line that passes close to atmospheric neon (**AIR**) and extends on toward mono-isotopic Ne-22 (^{22}Ne or Ne-E) as the final end product of mass-fractionation [42].

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

2. Conclusions

The precise data in Figures 1, 2 and 3 provide ***clear and unequivocal evidence*****:**

1. Neutron repulsion is the source of energy in cores of heavy atoms and stars
2. The Sun made our elements, birthed the solar system and sustains our lives
3. Iron-56 is the most abundant and most stable atom in the Earth and the Sun

In other words the conclusion to my journey, illustrated by the image on page 16, is scientifically valid. The solar pulsar is the source of every atom, life and planet in the solar system. The fountain of energy that sustains our lives and controls our destiny is powered by neutron repulsion - a source of energy Aston recognized in *"packing fractions"* as ***"power beyond the dreams of scientific fiction"*** [1.14*].

Unlike *"packing fractions,"* values of *"nuclear binding energy (B.E)"* minimize the effect of neutron repulsion and exaggerate that of proton repulsion. Such bias is in the long-term best interest of no one: It ultimately puts all human life at risk.

Homo Sapiens will hang together, and share information honestly, or risk sudden – but unexpected – death from natural causes. We have fortunately survived the last sixty-eight (2013 – 1945 = 68 yrs) years, despite official disinformation that was probably intended to protect humans from the possibility of nuclear annihilation.

To benefit from the precise experimental data presented here, each reader needs to actively challenge the conclusions of the author and his critics in order to decide: *Which is right? Is the pulsar-centered Sun an acceptable conclusion* ***for me*** ***?***

Acceptance of the pulsar Sun is as frightening to society now, as was Copernicus' conclusion in 1543 that Earth orbits about the Sun. But acceptance of this reality may free us from tyranny [ref. 1.8 and **E** in acknowledgements on the next page].

This chapter is a summary of major conclusions to the research project Professor Paul Kazuo Kuroda assigned to me in May 1960. Future chapters will historically review all research findings along the journey from 1960 to 2013.

*References in earlier chapters are cited by [Chapter number.Reference number].
****1-573-647-1377** or **omatumr2@gmail/com**

3. Acknowledgements

This Chapter is dedicated to seven brave souls who helped reveal answers to the intriguing solar puzzle. Paul K. Kuroda [**A**], Fred Hoyle [**B**], David Snell [**C**], Robert Jungk [**D**] and George Orwell [**E**] left hints in their autobiographies and other documents about strange events in 1945-46. Bill Streifer and Irek Sabitov [**F**] continue to investigate mysterious events in David Snell's report [**C**] and the downing of a B-29 bomber *"Hog Wild"* over Konan, Korea on 29 August 1945.

A. Paul Kazuo Kuroda, *My Early Days at the Imperial University of Tokyo* (auto-biography) http://www.omatumr.com/abstracts2005/PKKAutobiography.pdf

B. Fred Hoyle, *Home Is Where The Wind Blows: Chapters from a Cosmologist's Life* (University Science Books; First edition published on April 1, 1994) 443 pp. See especially pages 153-154: http://www.amazon.com/Home-Where-Wind-Blows-Cosmologists/dp/093570227X

C. David Snell, "Japan Developed Atomic Bomb; Russians Grabbed Scientists," *The Atlanta Constitution Headlines* (October 3, 1946) http://www.my-jia.com/The_Flight_of_the_Hog_Wild/Atlanta_Constitution_David_Snell_atomic_bomb_Korea.htm

D. Robert Jungk, *Brighter than a Thousand Suns: A personal history of the Atomic Scientists* (translated by James Cleugh), Mariner Books; 5th Printing edition (October 21, 1970) 384 pages. Originally published in 1956 by Alfred Scherz *Verlag as Heller als Tausend Sonnen* (German): http://www.amazon.com/Brighter-than-Thousand-Suns-Scientists/dp/0156141507

E. George Orwell (Eric Blair) "**1984**," Signet Classic (July 1, 1950) 328 pages http://www.amazon.com/1984-Signet-Classics-GeorgeOrwell/dp/0451524934

F. Bill Streifer and Irek Sabitov, *The Flight of the Hog Wild - A Preview* http://www.my-jia.com/The_Flight_of_the_Hog_Wild/preview.htm

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

References:

1. Peter Toth, "Is the Sun a pulsar?" *Nature* **270**, 159-160 (1977): http://www.nature.com/nature/journal/v270/n5633/abs/270159a0.html

2. V. A. Kotov, "A pulsar inside the Sun?" *Radiophysics and Quantum Electronics* **39**, 811-814 (1996): http://link.springer.com/article/10.1007%2FBF02120961

3. Oliver K. Manuel and Alberto Boretti, "Yes, the Sun is a pulsar," *Nature* (submitted 12 Dec 2012, but not reviewed): http://dl.dropbox.com/u/10640850/Yes_the_Sun_is_a_pulsar.pdf

4. P. K. Kuroda and W. A. Myers, "Plutonium-244 fission xenon in the most primitive meteorites," *Radiochimica Acta* **64** 167-174 (1994): http://adsabs.harvard.edu/abs/1994RadAc..64..167K

5. Oliver K. Manuel, "Neutron repulsion," *The APEIRON Journal* **19**, 123-150 (2012): http://redshift.vif.com/JournalFiles/V19NO2pdf/V19N2MAN.pdf

6. Fred Hoyle, *Home Is Where The Wind Blows: Chapters from a Cosmologist's Life*, (University Science Books; First edition published on April 1, 1994), 443 pp. **Pages 153-4** describe sudden, inexplicable changes in public opinions on the internal composition of the Sun after the Second World War ended. http://www.amazon.com/Home-Where-Wind-Blows-Cosmologists/dp/093570227X

7. Oliver K. Manuel, "Binding energy of the nucleus," Programme of the 1966 Annual APS Meeting in New York (26-29 Jan 1966), abstract EB1, *Bulletin of the American Physical Society*, volume **11**, no. 1, page 82.

8. Robley D. Evans, *The Atomic Nucleus* (McGraw Hill, Inc., 1955) 972 pp. See Figure 2.1 on page 35 (Or page 59 of the following pdf file, 1002 pp.): https://ia600306.us.archive.org/17/items/atomicnucleus032805mbp/atomicnucleus032805mbp.pdf

9. F. W. Aston, *Mass-Spectra and Isotopes* (Edward Arnold & Co., 1933) 248 pp.

*References in earlier chapters are cited by [Chapter number.Reference number].

****1-573-647-1377** or **omatumr2@gmail/com**

10. Gerhart Friedlander and Joseph W. Kennedy, *Nuclear and Radiochemistry* (First edition, John Wiley & Sons, 1955) 468 pp. Aston's packing-fraction curve is in Figure 2-1 (p. 34) of the first edition.

11. Gerhart Friedlander, Joseph W. Kennedy, Edward S. Macias and Julian Malcolm Miller, *Nuclear and Radiochemistry* (Third edition, John Wiley & Sons, 1981) 684 pp. Von Weizsäcker's graphs of average binding energy per nucleon have replaced Aston's packing-fraction curve in Figure 2-1 (p. 26-27) of the third edition.

12. O. Manuel. C. Bolon, A. Katragada and M. Insall, "Attraction and repulsion of nucleons: Sources of stellar energy," *Journal of Fusion Energy* **19**, 93-98 (2001): http://link.springer.com/article/10.1023%2FA%3A1012290028638

13. O. Manuel. E. Miller and A. Katragada, "Neutron repulsion confirmed as energy source," *Journal of Fusion Energy* **20**, 197-201 (2002): http://link.springer.com/article/10.1023%2FA%3A1023485018692

14. O. Manuel. C. Bolon and Max Zhong, "Nuclear systematics: III. The source of solar luminosity", *Journal of Radioanalytical & Nuclear Chemistry* **252**, 3-7 (2002): http://www.springerlink.com/content/kg8emwb74ak3lyrc/

15. W. Baade and F. Zwicky, "Cosmic rays from super-novae," *Proceedings of the National Academy of Sciences* **20**, 259-263 (1934).

16. O. K. Manuel, E. W. Hennecke and D. D. Sabu, "Xenon in carbonaceous chondrites," *Nature* **240**, 99-101 (1972) http://www.omatumr.com/archive/XenonInCarbonaceousChondrites.pdf

17. O. K. Manuel and D. D. Sabu, "Elemental and isotopic inhomogeneities in noble gases: The case for local synthesis of the chemical elements," *Trans. Missouri Academy Sciences* **9**, 104-122 (1975): Cited in *Proceedings of the 10th Lunar and Planetary Science Conference,* page 1969 (1979) http://tinyurl.com/lysdo7m

18. O. K. Manuel and D. D. Sabu, "Strange xenon, extinct superheavy elements and the solar neutrino puzzle", *Science* **195**, 208-209 (1977).

19. R. V. Ballad, L. L. Oliver, R. G. Downing and O. K. Manuel, "Isotopes of tellurium, xenon and krypton in the Allende meteorite retain record of nucleosynthesis," *Nature* **277**, 615-620 (1979): http://www.nature.com/nature/journal/v277/n5698/abs/277615a0.html

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

20. O. K. Manuel, "The enigma of helium and anomalous xenon," *Icarus* **41**, 312-315 (1980): http://www.sciencedirect.com/science/article/pii/0019103580900147

21. F. Begemann, "Isotopic abundance anomalies and the early solar system" in *Origin and Evolution of the Elements*, edited by N. Prantos, E. Vangioni-Flam and M. Cassé, M. (Cambridge University Press, Cambridge, UK, 1993) pp. 518-527

22. P. K. Kuroda and W. A. Myers, "Aluminum-26 in the early solar system", *Journal of Radioanalytical and Nuclear Chemistry* **211**, 539-555 (1997):

23. O. Manuel, K. Windler, A. Nolte, L. Johannes, J. Zirbel and D. Ragland, "Strange xenon in Jupiter," *Journal of Radioanalytical and Nuclear Chemistry* **238**, 119-121 (1998): See 2001 analysis of xenon isotope data from Jupiter: http://www.omatumr.com/abstracts2001/windleranalysis.pdf

24. E. M. Burbidge, G. R. Burbidge, W. A. Fowler, and F. Hoyle, "Synthesis of the elements in stars," *Reviews of Modern Physics* **29**, 547-650 (1957): Free abstract and pdf: http://rmp.aps.org/abstract/RMP/v29/i4/p547_1 and http://rmp.aps.org/pdf/RMP/v29/i4/p547_1

25. R. S. Lewis, B. Srinivasan and E. Anders, "Host phase of a strange xenon component in Allende," *Science* **190**, 1251-1262 (1975): http://www.sciencemag.org/content/190/4221/1251.extract

26. B. Srinivasan and E. Anders, "Noble gases in the Murchison meteorite: Possible relics of s-process nucleosynthesis," *Science* **201**, 51-56 (1978): http://www.sciencemag.org/content/201/4350/51

27. W. A. Fowler, "Forward" in *Cauldrons in the Cosmos: Nuclear Astrophysics* by Claus E. Rolf and William S. Rodney, edited by David N. Schramm (University of Chicago Press, Chicago, IL, USA, 1988) pp. xi-xii. http://www.omatumr.com/Fowler1988/CaldronsCosmos.pdf

28. O. Manuel, W. A. Myers, Y. Singh and M. Pleess, " Solar abundance of elements from neutron-capture cross sections", *Thirty-Sixth Lunar and Planetary Science Conference*, paper 1033 (2005): http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1033.pdf

29. O. K. Manuel and Golden Hwaung, "Solar abundances of the elements," Meteoritics 18, 209-222 (1983): http://tinyurl.com/224kz4

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

30. P. Eberhardt, J. Geiss, H. Graf, N. Grögler, M. D. Mendia, M. Mörgeli, H. Schwaller, A. Stettler, U. Krähenbühl, and H. R. von Gunten, "Trapped solar wind noble gases in Apollo 12 lunar fines 12001 and Apollo 11 breccia 10046," *Proceedings of the Third Lunar Science Conference* **2**, 1821-1856 (1972): http://tinyurl.com/ksy6e4b http://books.google.com/books/about/Trapped_Solar_Wind_Noble_Gases_in_Apollo.html?id=yJZutwAACAAJ

31. A. O. Nier, "A re-determination of the relative abundances of the isotopes of neon, krypton, rubidium, xenon and mercury," *Physical Review* **79**, 450-454 (1950): http://prola.aps.org/abstract/PR/v79/i3/p450_1

32. U. Frick, "Anomalous krypton in the Allende meteorite," Proceedings of the Eighth Lunar Science Conference 273-292 (1977): http://adsabs.harvard.edu/full/1977LPSC....8..273F

33. J. H. Reynolds, U. Frick, J. M. Neil and D. L. Phinney, "Rare-gas-rich separates from carbonaceous chondrites," *Geochimica Cosmochimica Acta* **42**, 1775-1797 (1978): http://www.sciencedirect.com/science/journal/00167037/42/12

34. P. K. Kuroda and O. K. Manuel, "Mass fractionation and isotope anomalies in neon and xenon," *Nature* **227**, 1113-1116 (1970): http://www.nature.com/nature/journal/v227/n5263/abs/2271113a0.html

35. D. D. Sabu and O. K. Manuel, "Xenon record of the early solar system," *Nature* **262**, 28-32 (1976): http://www.nature.com/nature/journal/v262/n5563/abs/262028a0.html

36. D. D. Sabu and O. K. Manuel, " "Noble gas anomalies and synthesis of the chemical elements," *Meteoritics* **15**, 117-138 (1980): http://tinyurl.com/yqdafh

37. E. Anders and N. Grevesse, "Abundances of the elements: Meteoritic and solar," *Geochimica Cosmochimica Acta* **53**, 197-214 (1989): http://www.academia.edu/3294725/Abundances_of_the_elements_Meteoritic_and_solar

38. W. D. Harkins, "The evolution of the elements and the stability of complex atoms," *Journal of the American Chemical Society* **39**, 856-879 (1917).

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com

39. O. K. Manuel, “Noble gases in the Fayetteville meteorite,” *Geochimica Cosmochimica Acta* **31**, 2413-2431 (1967): http://www.sciencedirect.com/science/article/pii/0016703767900129 http://adsabs.harvard.edu/abs/1967GeCoA..31.2413M

40. D. P. Richardson, "The Fayetteville, Arkansas meteorite," *Popular Astronomy* **43**, 384 (1935): http://tinyurl.com/6nbzv44 http://adsabs.harvard.edu/full/1935PA.....43..384R

41. O. Manuel and Stig Friberg, “Composition of the solar interior: Information from isotope ratios,” *Proceedings SOHO 12/GONG Conference on Local and Global Helioseismology: The Present and the Future*, 27 Oct-1 Nov 2002, Big Bear Lake, CA, U.S.A. (*ESA SP-517*, editor: Huguette Lacoste) pp. 345-348 (2003): http://www.omatumr.com/abstracts/gong-2002.pdf

42. D. D. Sabu and O. K. Manuel, "The neon alphabet game," *Proceedings of the Eleventh Lunar & Planetary Science Conference* **15**, 879-899 (1980): http://tinyurl.com/2944m9 and http://tinyurl.com/36zvrt

*References in earlier chapters are cited by [Chapter number.Reference number].

**1-573-647-1377 or omatumr2@gmail/com