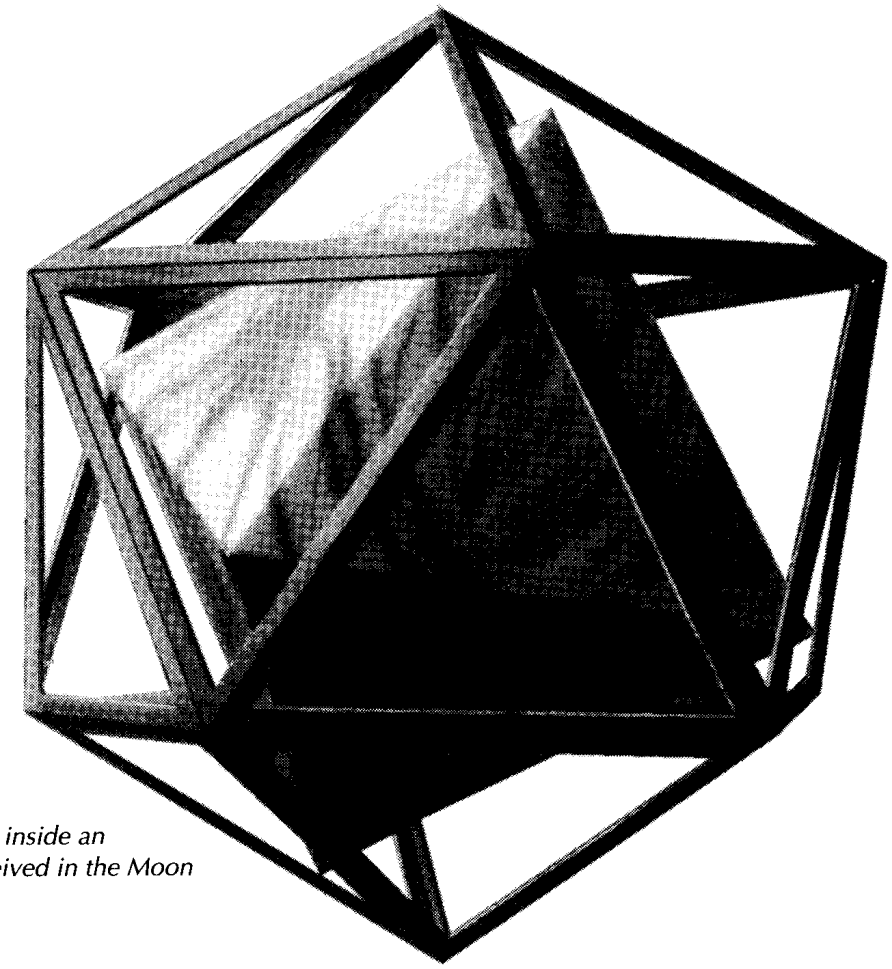
The Elements, The Solar System, and The Prebiotic Principle

by Laurence Hecht

A new look at the geometric model of the atomic nucleus proposed by Robert J. Moon, a physical chemist in the anti-Bohr tradition.



An octahedron nested inside an icosahedron, as conceived in the Moon model.

Illustration by Christopher Sloan

The coincidence of the Moon nuclear model—taken as a topological ordering principle for the 92 elements—with the Kepler ordering of the planetary orbits, has not been sufficiently explored (see accompanying article, page 31, for summary of the model). My recent experimental-constructive investigations, pursuing the placement of neutrons in the vacancies allowed in the Moon-model geometry, confirm the validity of the Moon model in accounting for a variety of otherwise anomalous features of nuclear chemistry. These include, especially, the leading anomalous features of the ordering of the isotope species, sometimes referred to as "magic numbers," and related peculiarities of the nuclear transmutations, which are explained under the Moon nuclear model in a way that should begin to supplant the patchwork quilt of Ptolemaic formulations employed in the "standard model" approach to nuclear physics.

I will elaborate these matters, still under investigation, in greater detail in a subsequent report. Meanwhile, certain more general considerations, bearing on the question raised in a number of Lyndon H. LaRouche's recent works,[1] of the relationship among the distinct, but multiply connected domains of biotic, abiotic, and cognitive, have come to light in the course of this work. I confine myself here, largely to these general considerations.

Kepler's ordering of the planetary orbits, as derived in his 1596 *Mysterium Cosmographicum*[2] proceeds in the sequence:

octahedron
icosahedron
dodecahedron
(a discontinuity marked by the tetrahedron)
cube.

The Moon nuclear model describing the ordering principle for the 92 elements, proceeds in the sequence:

cube
octahedron
icosahedron
dodecahedron
(a discontinuity marked by the partial formation of a second, twinned dodecahedra/icosahedra shell)
cube
octahedron. . ., etc.

If, in Kepler's model, a cube is inscribed within the sphere which designates the orbit of Mercury, and, within that cube, a sphere, which designates the region of immediate influence of the Sun, it is seen more clearly that the orderings are virtually the same!

Knowing what we know of the significance of the Platonic solids as a topological ordering principle, and of the principle variously expressed as *microcosm-macrocosm,* or Leibniz's *monad,* it would be both foolish and irresponsible to acquiesce to the crude empiricism and radical indifferentism of contemporary scientific discourse, either in giving ground to the argument that these are merely matters of "coincidence," or, in failing to recognize their crucial importance, because they are "merely" of a topological, as opposed to metrical, nature. The demand of present-day ignoramuses, most often of mathematical-physics training, that one must "prove it—show me how it corrects a measurement of some existing (non-understood) fundamental value," is what is to be avoided here. Even a scant familiarity with the actual history of scientific progress, will show that all important discoveries of physical principle proceed by identification of an appropriate transfinite ordering principle governing crucial anomalies. As with Kepler's solar system, so with Mendeleev's explicit rejection of the Galileo-Newton universe, in his recognition that the atomic masses of the elements do not obey a continuous function, but are *periodic.*[3]

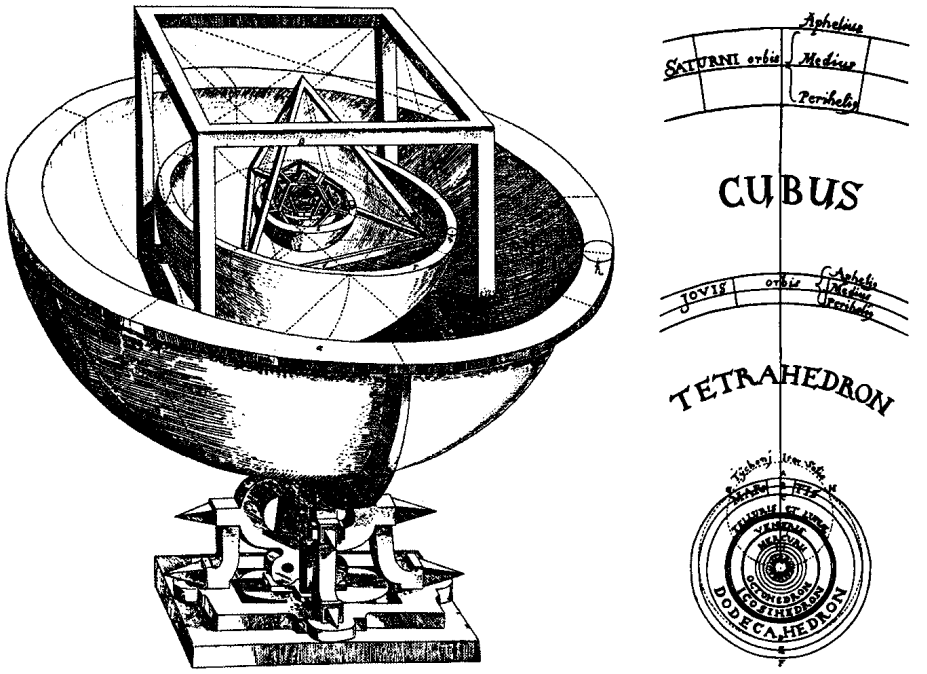
The Prebiotic Principle

By *prebiotic principle,* I mean, in first approximation, the evidence that something resembling life is present in the developmental process governing the elements and nuclides. Familiarize yourself with the *Aufbau Prinzip* (construction principle) of the nuclides, as determined by the Moon model, and you will recognize, as I did recently with a Eureka-like shout: "These are individuals!" That is—as I discovered through several weeks of concentrated, hands-on experience—in constructing the Moon model structure including the neutron placements, no attempt to extrapolate (as by a preconceived notion of directionality) the configurations of successive elements, or their isotopes is possible.

The configuration of each successive element, and even of each successive isotope, introduces some new topological relationship, reflecting the fact that the nested array of Platonic solids (and the subsumed sequence of cyclic solids defined by the edge midpoints) is governed by a multiply connected topological ordering.[4] The reason for the failure of earlier efforts to derive such an *Aufbau Prinzip* was the rejection of Kepler's Pythagorean-Platonic conception of ordering. Thus are all efforts to construct the nucleus out of such reductionist notions as the close-packing of spheres (Pauling, Monti, et al.), Goeppert-Mayer and Jensen's shell model, and the even more ivory-tower-like approach of the standard-model theory, doomed to failure.

As an aid to adducing a clearer conception of my use of the term *prebiotic,* note the following two points.

First, the periodic table can be seen as a kind of menagerie of the sort which Geoffroy-St. Hillaire and the young Cuvier worked with in Paris of the 1790s. The periodic table is the zoological laboratory, where creatures of the sort Leibniz called *lesser monads* are to be found and studied. The key to their classification is the Moon nuclear model. The individuality of each nuclear species (element), and its varieties (isotopes), is the strongest indictment of the crude form of atomism—decisively rejected by both Lavoisier and Mendeleev—in which each element is seen merely as the agglomeration of successive numbers of elementary parts. These are individuals. Hence, the first hint for use of the term prebiotic.



Kepler's ordering of the planetary orbits and the Platonic solids, reproduced from his 1596 Mysterium Cosmographicum.

The second point brings us to another crucial feature of what Leibniz called his Monadology, one also referenced by Nicholas of Cusa under the headings minimum-maximum principle and microcosm/macrocosm: Namely, the evolutionary principle for these species of lesser monads (and here, as with the case of biology, one must avoid being drawn into attempts to explain evolution by plausible "mechanisms"), is the topological relationship governed by the dodecahedron and golden section. The same principle expresses itself in living processes. Thus, we have the identical topological organizing principle expressing itself in events on an astronomical, visible, *and microphysical* scale. The first and last lie in the domain of abiotic process; the middle lies in the domain of living.

The identity of topological ordering principle in the astronomical and biological domains has been known since the time of Kepler. In his beautiful paper inspired by Braun and Schimper's 1828 discovery of the law of phyllotaxis, Gauss's American devotee Benjamin Peirce extended that identity, by demonstrating the appearance of the Fibonacci series in the relationships of the periods of successive planets—a relationship he humorously dubbed the "vegetable principle" in the universe.[5] Dr. Moon's nuclear model demonstrates that same principle of golden-section-ordered topology, as governing the microcosm. No atomic nucleus is without it. Thus, the abiotic domain is suffused with a principle which finally finds its fuller expression in the biotic. Hence, again, the term "prebiotic."

Schroedinger's Confusion on Crystallization

An apparent confusion, overemphasized by Schroedinger's treatment of the topic, arises in the study of crystallography. Schroedinger attempted to illustrate the distinction of living from nonliving, by reference to the distinction between crystal growth and the growth of a biologic organism.[6] The former appears as a process of agglomeration of identical parts (although that conception itself breaks down upon closer examination), exhibiting the six-fold symmetries of cube and octahedron. The latter is a developmental growth, characterized by differentiation, and exhibiting the five-fold symmetry of the icosahedron-dodecahedron and the divine proportion. In Schroedinger's formulation, the former is entropic, the latter non-entropic. However, once the evidence demonstrated by the Moon nuclear model is taken into account, the superficiality of the Schroedinger treatment is seen.

Beneath the surface of the molecular or ionic chemistry, which is usually taken as determining the crystalline forms, lie the nuclear processes which are determining, even if our present understanding cannot elaborate exactly how. There are no ions or molecules, and therefore no electronic chemistry, without nuclei. And there, in the nucleus, the evidence of an ordering principle common to living processes appears again. It is not life, but it expresses the principle in an inchoate form; it is prebiotic.

Crystallization is a most interesting phenomenon, and a most important one in the history of scientific progress. It is Schroedinger's misevaluation of the similarity and differences between crystallization and organic growth which is misleading. The problem arises, in part, from an artificial separation of nuclear "physics" from chemistry, a problem which reflects a deeper epistemological sickness within the body of science. No form of chemical combination, including the crystalline state, can be properly understood apart from the understanding of the nucleus. Thus, recognizing the validity of the Moon nuclear model as a topological ordering principle for the microcosm, we would see the crystalline form as an intermediate expression of that. Crystals, then, are like the hair and nails of the prebiotic microcosm. To attempt to conclude fundamental facts from the study of crystallization, in itself, would be like studying animal physiology, while restricting one's investigations to the fur and scales of the beast.

Yet, even such an approach, properly carried out, could yield fruit, for there is no place in the universe where the hand of creation will not show itself. Two types of anomalies associated with crystalline growth are noteworthy in this connection.

First, is the recently discovered phenomenon, observed in the case of metal alloys subjected to extreme conditions, of the appearance of quasiperiodic crystalline forms of five-fold symmetry. Second, and more curious, are certain anomalous conditions of the crystalline state, noted by Pasteur, which also suggest a higher, non-entropic organizing principle. Here, for example, we find the selective rotation of the plane of polarization of light by chiral crystals. The specific handedness of the crystals formed by the living substance is only one expression of this anomaly. The prebiotic principle is equally revealed in the paradoxical fact that the solution of such chiral crystals, itself, acts, in part like a crystal, rotating the plane of polarization of the incident light, but also, in part like an anisotropic substance, in that the same rotation occurs *irrespective* of the direction of incidence of the light.

In this most paradoxical phenomenon, one finds a hint of an ordering principle which must lie outside the ordinarily conceived laws of crystallization. A closer consideration of an even more elementary feature of crystallization suggests the same thing. For, ask yourself, why do the faces of a growing crystal remain flat? The usual explanation, that the rates of growth in particular directions are somehow favored, leaves something to be desired. One is led to the view that the solution from which the crystal grows is itself a "quantized space."

A fuller treatment of the topic would require an examination of the seeming appearance of entropy under certain exceptional conditions. We leave this for another time. Our treatment of crystallization demonstrates the type of approach to be used. Leibniz's works on dynamics had already shown the absurdity of the Newtonians' introduction of the entropy concept into physics. The introduction of this concept into chemistry, by Clausius, Maxwell, et al. comes from a foolish interpretation of statistical gas laws. What can properly be adduced from such considerations are the notions of *atomicity* and *quantum of action.* The first was so adduced, as Ampère reports his independent discovery of the Avogadro Law in the 1814 "Lettre a Berthollet,"[7] by consideration of Mariotte's (Boyle's) Law and the calculus of probabilities; the second, by Planck's considerations of the anomalies of blackbody radiation. The relevant, special importance of Ampère's much overlooked 1814 work, is that Gay-Lussac's Law of Simple Proportions, and chemical combination in general, is given a geometric treatment, under which the laws of crystallization are naturally subsumed.

Had Ampère's methodological approach taken hold, instead of the bookkeeping representation of chemical formulae which still persists in spite of all contrary evidence, the silly representation of entropy could not have arisen. Clausius would probably have drowned himself in a large fishbowl, like Thomas Gray's favorite puss, grasping for the gold prize. I suspect the actual law of entropy is this: Let a fool suspect that he has got his hands on the "ultimate particle," and he will surely wear it down with rubbing.

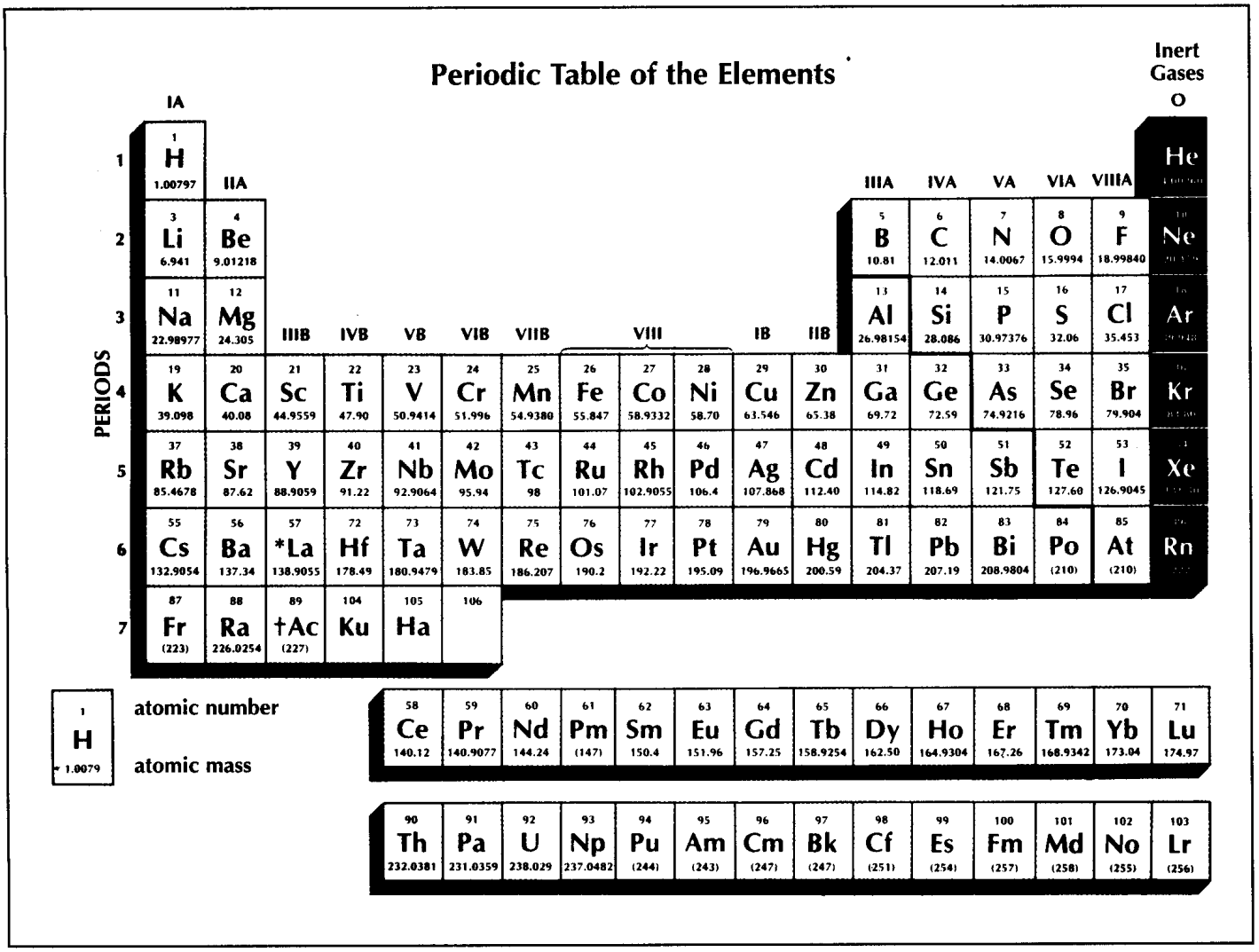
On Elements and the Solar System

The correspondence of topological ordering principle in the Moon and Kepler representations, bears also on the general topical areas: the origin of the solar system, and the synthesis of the elements.

Before entering into this admittedly still very conjectural topic, I think a word of warning is necessary. Most efforts to account for the origin of the solar system, as with cosmology in general, are marred by the introduction of *ad hoc* assumptions which extend far beyond what scientific evidence would permit. Once these assumptions are granted, the formulations of an ivory-tower mathematical-physics are applied, to produce a plausible "model" resembling the desired result. The same flaw is introduced in most approaches to the problem of the synthesis of the heavier elements; there is too much air, and not enough ground. It is an important part of one's self-inoculation against such hoaxes, always to keep in mind that theories of origin, and cosmology in general, have ever been closely associated with the needs of an oligarchical ruling elite.

That said, several things are suggested by the correspondence of the Moon and Kepler models. Here follow some scant, early reflections on the subject. At first sight, the solar system, in its gross structure, appears to be an incomplete expression of the same ordering principle governing the elements. Where there are 92 principal singularities on the latter and 148 more of derived nature, the solar system shows only a mere nine principal orbits, and some moons, these all restricted largely to a single plane. Yet, in some way the opposite must be the case—the solar system, which is the more developed form, must be the more developed expression of the ordering principle. The fact that all matter within this solar system is composed of huge numbers of tiny nuclei, each built upon the same plan as the structure in the large, is one expression of this, and also a beautiful embodiment of the macrocosm/microcosm principle.

Certain features of the two systems, however, are the same. The appearance of the discontinuity following the dodecahedron corresponds in the one case, to the distinc-



tion of the small, earthy inner planets from the large gas giants beyond the asteroid belt; in the other case, to a rough distinction between light and heavy, abundant and rare, elements. The four shells, cube-octahedron-icosahedron-dodecahedron, represent the domains of Mercury, Venus, Earth, Mars, with the hydrogen-rich Sun at center, and this must in some way correspond to the nucleosynthesis. Thus, imagine the surrounding space as a great solution within which the solar system crystallizes, not by the laws of solution chemistry, but by the underlying principle expressed in nucleus and solar system.

As I contemplate these things, I see reflected in the pentagonal Plexiglas face of my model of the Moon nucleus, the wind-blown leaves of a large maple tree (pentagonal leaves, if you have ever examined them), and through them a very blue, spring sky. There, in the momentary contemplation of a single image, the multiply connected domains of prebiotic, living, and creative express themselves in unitary simplicity, and conspire to produce a feeling of spiritual pleasure.

The author is the editor-in-chief of 21st Century. *This article was written April 27, 2003.*

Notes

1. See, for example, Lyndon H. LaRouche, Jr., "The Weird Religions of Cheney's Empire: The Pantheo-cons," *Executive Intelligence Review,* May 2, 2003, pp. 12-35.
2. Johannes Kepler, *Mysterium Cosmographicum,* (New York: Abaris, 1981), As Kepler remarks in notes added 25 years after the first publication, the germ of all his subsequent work, leading to the the discovery of the principle of universal gravitation and the *Harmonies of the World,* is contained in this early (1596) work of his.
3. D. Mendeleeff,"The Periodic Law of the Chemical Elements," (Faraday Lecture, June 4, 1989), in D. Mendeleeff, *The Principles of Chemistry,* Third English Edition (London: Longmans, Green, 1905; New York: Kraus Reprint, 1969) Vol. II, Appendix II.
4. I discovered this in an investigation of the reason behind the magic numbers 50 and 82. Each represents a different anomalous feature of the Moon model construction. For example, the reason for the extraordinary stability of 50-Sn (tin) is the completion of the first pentagonal ring (the "scalloped salad bowl") of the twinned dodecahedron. One would have expected this structure to appear at atomic number 51, when five protons have been added to the 46 of the first completed structure. The completely unexpected nature of this particular *individual* (50-Sn) derives from the fact that the proton from the underlying icosahedron on the face of the first complete (46-proton) structure "pops up" to form the fifth proton in the ring on the twinned structure. This explains both the reason why tin expresses itself in the greatest number of stable isotopes (10) of any element, and also the extraordinarily anomalous, "forbidden" transmutation of 49-indium-115 into 50-tin-115.

   Similarly, in respect to the "magic number" 82. In the careful construction of the elements of the Lanthanide series (itself an anomaly, the gross features of which are readily explained by the Moon model), it is seen that the structural anomaly producing the "magic" number of 82 neutrons arises from the need to locate the octahedron within the partially completed dodecahedral and icosahedral "salad bowls." Because of the skew positioning of the octahedral vertices within the face of the icosahedron, the protons forming at the octahedral vertices lie on a sphere which is almost equivalent in radius to the midsphere of the icosahedron, upon which the neutrons lie. Thus, in the formation of some of the first members of the Lanthanide series, the addition of protons, which, in the general case, will create more neutron positions, actually eliminates some neutron positions. This is the reason that successive even-numbered elements in the series continue to show 82 neutrons in their stable isotopes.
5. B. Peirce, "Mathematical Investigations of the Fractions which Occur in Phyllotaxis," *Proceedings of the American Academy for the Advancement of Science* (1849), pp. 444-447.
6. Erwin Schroedinger, *What Is Life?* (Cambridge University Press, 1944).
7. André-Marie Ampère, "Lettre de M. Ampère a M. lecomte Berthollet sur la determination des proportions dans lesquelles les corps se combinent d'après le nombre et la disposition des molécules dont leurs particules intégrantes sont composées," *Annales de Chimie,* Tome 90 (30 April 1814), pp. 43-86 + 2 planches.

What Is The Moon Model Of the Nucleus?

In 1986, Dr. Robert J. Moon, the University of Chicago physical chemist and veteran of the Manhattan Project, conceived a new model for the atomic nucleus, which could account for many of the otherwise anomalous properties of the elements and isotopes.[1] Moon's was the first comprehensive attempt, since Dmitri Mendeleev proposed the Periodic Table in 1869, to find a new principle governing the ordering of the elements.

Dr. Moon had been a key participant in a mid-1980s seminar series, which was conducted by Lyndon H. LaRouche, Jr. with some of the leading non-Establishment figures in plasma physics, biophysics, and related disciplines. The seminar series was a crucial part of LaRouche's efforts at the time to push forward his proposal for the Strategic Defense Initiative, partially adopted by President Ronald Reagan in 1983, as a science-driver project.[2] The method of Johannes Kepler, in his discovery of the principle of Universal Gravitation and founding of modern experimental science—as distinct from the crude empiricism of Galileo and Newton—was a frequently visited topic in these discussions.

Sometime in the spring of 1986, at the prompting of Charles B. Stevens, a leading collaborator of LaRouche on science matters, Dr. Moon undertook a concentrated study of LaRouche's epistemological writings, supplemented with a reading of Kepler's *Mysterium Cosmographicum.* A lifetime of immersion in physical chemistry and nuclear physics, which had begun with his youthful apprenticeship to William Draper Harkins at the University of Chicago, came to fruition that spring in the still quite fertile and imaginative mind of the then 74-year-old Moon.

I first saw the Moon model of the nucleus early in the summer of 1985. Moon had inspired a retired machinist friend, George Hamann, to build a set of nested Platonic solids in the ordering and sizes specified. Using that model, made from used aluminum printing plates, Dr. Moon first showed me the construction of the atomic nuclei for the 92 elements. In Moon's model, the ordering principle for the protons is represented by the vertices of a nested structure of four of the five Platonic solids (Figure 1). Eight protons, corresponding to the Oxygen nucleus, occupy the vertices of a cube which is the first nuclear "shell." Six more protons, corresponding to Silicon, lie on the vertices of an octahedron, which contains, and is dual to, the cube. The octahedron-cube is contained within an icosahedron, whose 12 additional vertices, now totalling 26 protons, correspond to Iron. The icosahedron-octahedron-cube nesting is finally contained within, and dual to, a dodecahedron. The 20 additional vertices, now totalling 46 protons, correspond to Palladium, the halfway point in the

periodic table (Figure 2).

Beyond Palladium, a second dodecahedral shell begins to form as a twin to the first. After 15 of its 20 vertices are filled at Lanthanum (atomic number 56), a cube and octahedron nesting fill inside it, accounting for the 14 elements of the anomalous Lanthanide series.

Next, the icosahedron forms around the cube-octahedron structure, completing its 12 vertices at Lead (atomic number 82), which is the stable, end-point in the radioactive decay series. Finally, the dodecahedron closes, and the twinned structure "hinges" open, creating the instability which leads to the fissioning of uranium (Figure 3).

The completed "shells" of the Moon model, correspond to the elements whose stability is attested by their abundancy in the Earth's crust: Oxygen, Silicon, and Iron. These elements also occur at *minima* in the graphs of atomic volume, and of other physical properties (viz. compressibility, coefficient of expansion, and reciprocal melting point) as established by Lothar Meyer in the 1870s to 1880s. Palladium, which is an anomaly in the modern electron-configuration conception of the periodic table—because it has a closed electron shell, but occurs in the middle of a period—is not anomalous in the Moon model. Further, all four closed-shell elements in the Moon model occur at maxima on the graph of paramagnetism (versus atomic number), as reported by Harkins.[3]

The Moon model is thus consistent with much of the same experimental data which underlie the periodic table of the elements, and explains additional features not explained by the modern, electron-configuration presentation of the periodic table. However, it seems to be inconsistent with the evidence from spectroscopy (upon which the electron-configuration conception rests) which suggests the periods of 2, 8, 18, and 32; it also appears, at first, inconsistent with the older "law of octaves," which was developed to explain the phenomena of chemical bonding, and was subsumed in Mendeleev's conception.

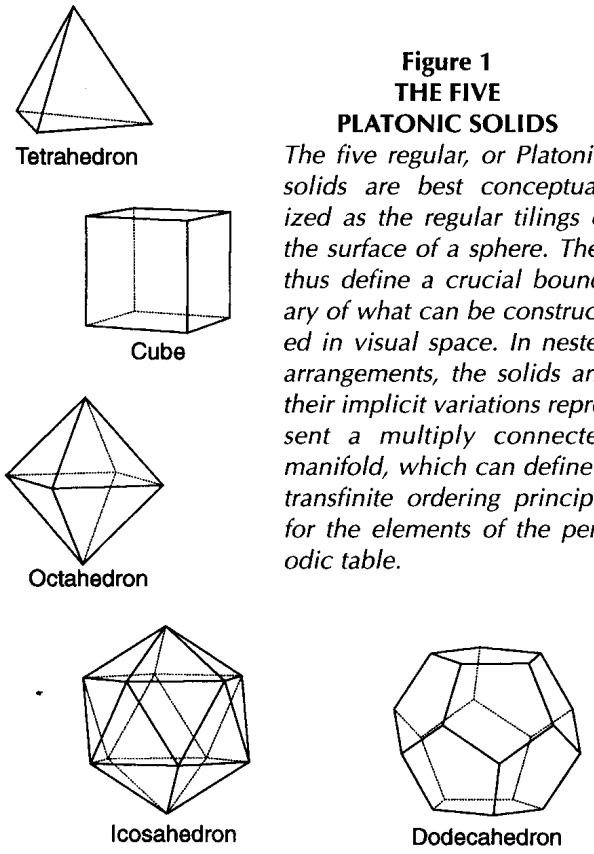


Figure 1
THE FIVE PLATONIC SOLIDS

The five regular, or Platonic, solids are best conceptualized as the regular tilings of the surface of a sphere. They thus define a crucial boundary of what can be constructed in visual space. In nested arrangements, the solids and their implicit variations represent a multiply connected manifold, which can define a transfinite ordering principle for the elements of the periodic table.

An Ordering of Neutrons

From the period of my first exposure to Moon's nuclear model, I was of the opinion that the two apparently contradictory orderings (electron and proton) must be governed by some higher principle, which was in some way contained in the Moon conception. Moon encouraged such speculations, pointing out that the theory of electron orbits (the "extra-nuclear electrons," as he insisted on calling them), had always suffered from an aseptic separation of the electron from the nucleus.

During his lifetime, I worked out an ordering principle,

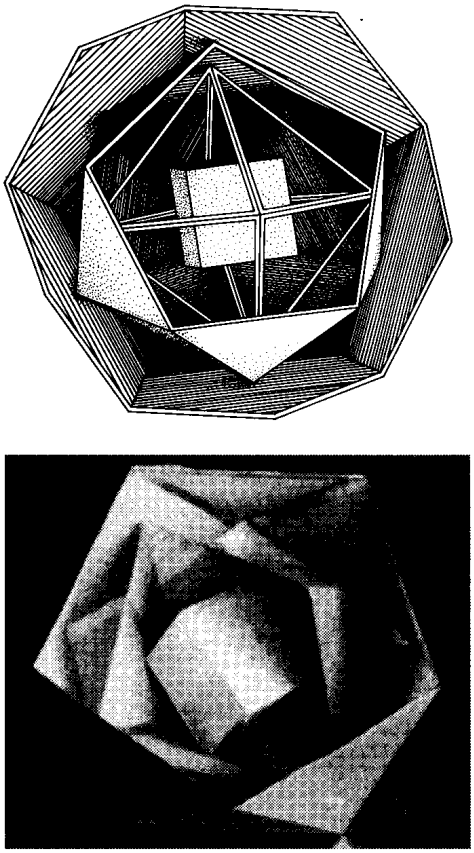


Figure 2
A WORKING MODEL OF THE NUCLEUS

The Moon model of the nucleus employs a nesting of four of the five Platonic solids, similar to that conceived by Johannes Kepler to describe the Solar System (top). Below is a photograph of a working model of the nucleus, made for Moon by retired machinist George Hamann in 1986. The scale model was constructed out of used aluminum offset printing plates.

Philip Ulanowsky

Dr. Moon around the time that he conceived of his model of the nucleus.

using the edge midpoints and unfilled faces of his nested configuration, to determine the otherwise undetermined distribution of the neutrons in the nuclei.[4] In any Platonic solid, there are three implied spheres of differing radii. The unique characteristic of the Platonic solids is the existence of a circumscribing and inscribing sphere. Intermediate between these, there is a sphere, sometimes referred to as *midsphere* (Figure 4). For the two pairs of dual Platonic solids (cube-octahedron and icosahedron-dodecahedron), the midspheres pass through the vertices of the two related Archimedian solids, that is, the cuboctahedron and icosidodecahedron. (These cyclic, Archimedian solids, are formed by connecting the midpoints of either of the Platonic solid duals.)

The existence of this subsumed ordering principle of the cyclic Archimedian solids, within the multiply connected ordering of the nested Platonic solids, suggested the appearance of a new physical singularity in this region. So, this third set of spheres was to be the primary location for the neutrons, in my extended conception of Moon's model. I assumed the addition of the fifth Platonic solid (tetrahedron) as the structure of an alpha particle at the center of the nucleus, and distributed the neutrons at the unoccupied edge-midpoints of the set of solids. When I did so, I found that the neutron "shells" closed at the electron-shell singularities (2-Helium-4, 10-Neon-20, 18-Argon-40, 36-Krypton-84), specified in the modern periodic table (See table, p. 34).

This suggested, for the first time, a relationship between the ordering of the nucleus and that of the electron shells. However, I could not see a cause for a relationship between the supposedly neutral neutrons, and the extranuclear electrons. The difficulty suggests some error of assumption, which must be contained in the oversimplification provided by the Rutherford-Bohr model.

Three years ago, aided by my recent study of the Ampère-Gauss-Weber electrodynamics, I made an attempt to establish a physical cause for the Moon model structure, by imagining the protons as occupying a set of current rings, like the Ampère *magnetic molecule,* which rings were arranged to correspond to the symmetries of the nested solids.[5] This did not prove entirely satisfactory.

More recently, at LaRouche's suggestion, I dropped the effort to explain the Moon model in terms acceptable to existing physics practice, the thinking being that there is something new here, which, by its nature, could not be explicable in the old terms. Rather, I concentrated on looking at some of the key anomalies in the existing view of the ordering of elements and isotopes, and examined how the Moon model, considered as a valid ordering principle for the nuclear structure, could resolve them. With that in mind, a suggestion by Dr. Ben Soldano proved useful. In noting to him, the seemingly paradoxical coincidence in ordering between the neutrons and the extranuclear electrons, referred to earlier, he suggested looking at the nuclear transmutations, such as the *K-capture,* and electron and positron emissions.

That soon led me back to an examination of the so-called

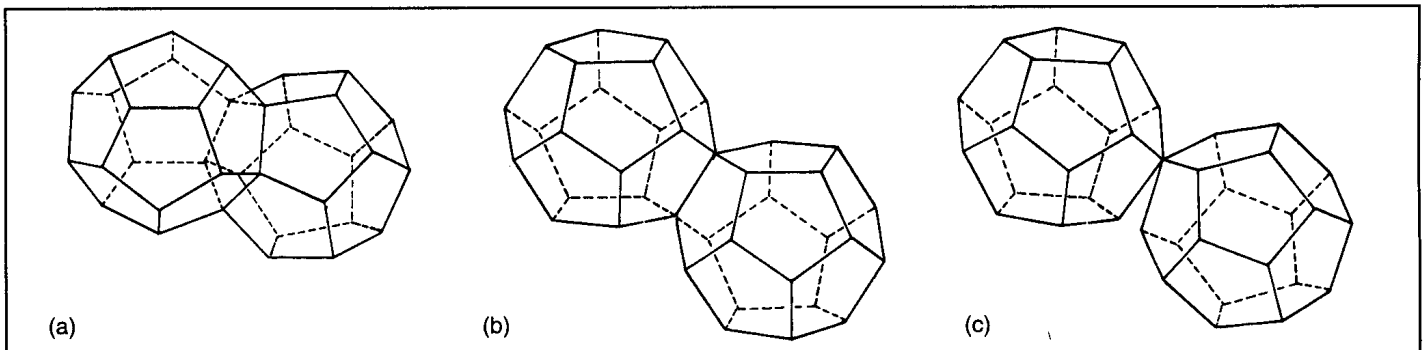
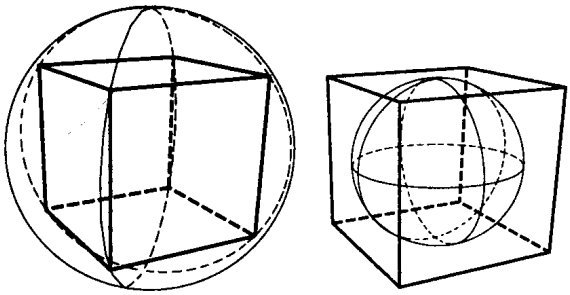
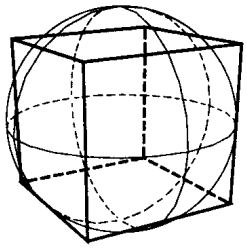


Figure 3
THE COMPLETED URANIUM NUCLEUS

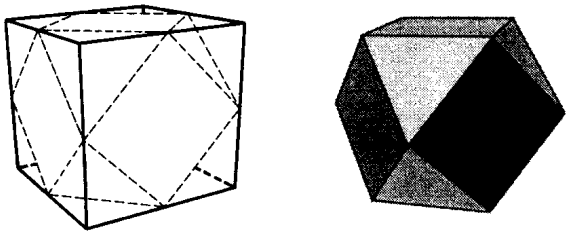
(a) To go beyond Palladium (atomic number 46), which is represented by the completed dodecahedron, an identifcal dodecahedron joins the first one at a face. When the second dodecahedron is completed, it is seen that six positions on the common dodecahedral face are already occupied. This represents the nucleus of radon (atomic number 86).
(b) To go beyond Radon, the twin dodecahedra open up, using a common edge as if it were a hinge.
(c) To create 91-Protactanium, the hinge is broken at one end. To create 92-Uranium, the position where two protons join must be slightly displaced, creating the instability which permits fission.



(a) Cube with circumsphere and insphere



(b) Cube with midsphere

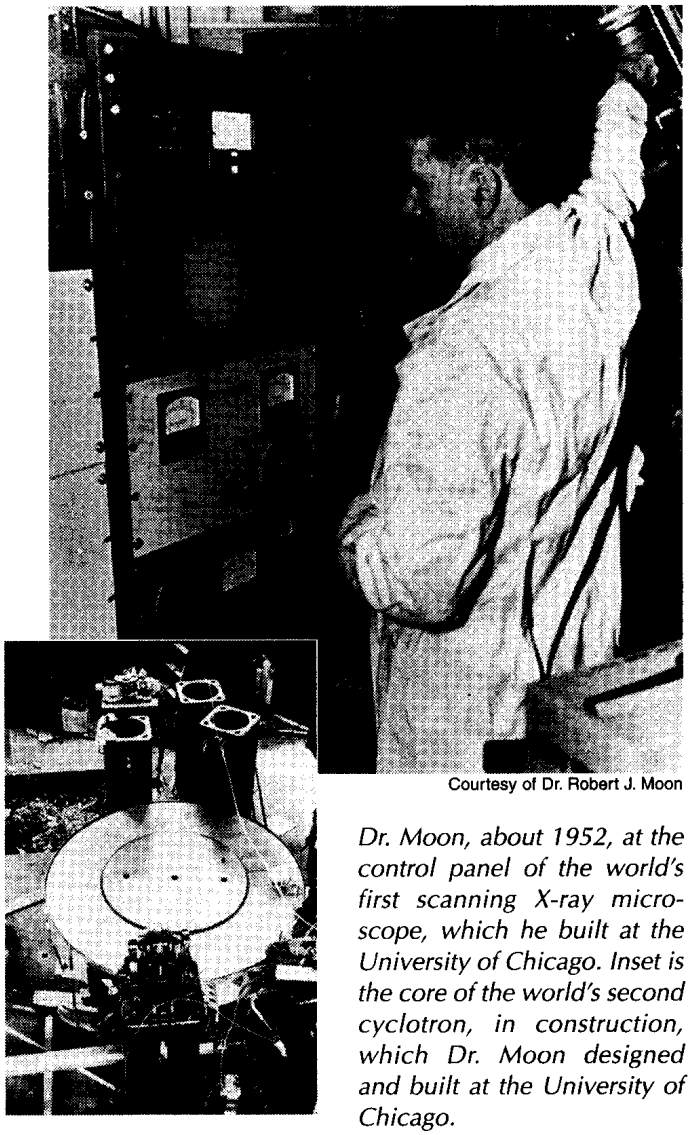


(c) 12 points of cube forming the cuboctahedron

Figure 4
THE MIDSPHERE, LOCATION OF THE NEUTRONS

Every Platonic solid has a circumsphere, insphere, and midsphere. In (a), we see the circumsphere of the cube, which passes through the 8 vertices, and the insphere, which is tangent to the 6 faces of the cube. The midsphere (b), which is intermediate in radius, touches the midpoints of the 12 edges of the cube. When these 12 points are conected (c), the figure formed is the Archimedean solid known as the cuboctahedron. It is cyclic, in that it can be constructed from 4 rings, each of whose circumference is divided in 6 parts.

magic numbers. Rather than accepting the usual interpretation of spin-orbit coupling and other tenuous concepts to explain these phenomena, I simply viewed the magic numbers as a catalogue of anomalies, of unusually stable isotopes and "forbidden" transmutations. I looked, in particular, at the magic numbers 50 and 82, wishing to see how the complex geometry of Moon's nested nuclear model might favor that number of protons or neutrons. This required a more exact construction of the Moon model representation for some of these heavier nuclei, than I had previously carried out. The results were rewarding. A summary description is provided in Note 4 to the main article here (p. 30). These could be taken as preliminary confirmation of the extended validity of the Moon's nuclear



Courtesy of Dr. Robert J. Moon

Dr. Moon, about 1952, at the control panel of the world's first scanning X-ray microscope, which he built at the University of Chicago. Inset is the core of the world's second cyclotron, in construction, which Dr. Moon designed and built at the University of Chicago.

hypothesis, respecting the otherwise unexplained reason for the distribution of the isotopes, the second "tier" of the periodic table.

—Laurence Hecht

Notes

1. Robert James Moon (1911-1989) began studies at the University of Chicago at the age of 16, in 1928. Wishing to solve the problem of controlled thermonuclear fusion, he went to Arthur Compton, then chair of the Physics Department, who sent him to the chairman of the Department of Physical Chemistry, William Draper Harkins. Harkins had challenged the Bohr orbital model of the atom as early as 1917, arguing (1) that no known chemical system was flat, like the proposed Bohr orbits which form the basis for modern quantum mechanics; and (2) Bohr's system limited itself to radiation phenomena, although the chemical knowledge of the atom was much broader.

   Moon earned a doctoral degree in Physical Chemistry, under Harkins, and then one in Physics, and taught in both departments at the University of Chicago.

   In the mid-1930s, Moon led construction of the second cyclotron in the world, with many improvements over the first device constructed by E.O. Lawrence (Moon, R.J. and Harkins, W.D, *Science*, Vol. 83, No. 244 (1936). During the Manhattan Project, he solved the problem of the carbon moderator, making the first atomic pile possible. After the war, he constructed the first scanning X-ray microscope, and pioneered in optical biophysics studies on the action potential in nerves.

   Moon's study of the electrodynamic theories of André-Marie Ampère and Wilhelm Weber, led him to reconsider the usual interpretation of the Rutherford scattering data, which ignores the variation in force between charged particles as a result of relative velocities and accelerations.