

Foreword [LH Flint, *Hydration & Biology*, 1968]
by Stuart Hale Shakman [©2014; edited 9-27-2015]
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"It's mind-boggling." said Dr. Ponomperuma.

The late Dr. Cyril Ponomperuma of the U. of Maryland was an authority on the origin of life. When he was reached via telephone in July/Aug., 1983, he spoke of how he and other scientists had been investigating the origins of life in the laboratory over the past 25 years, trying to recreate the conditions that had existed billions of years ago. Their assumption had been that these conditions no longer existed. But Dr. Ponomperuma nearly bubbled over in excitement as he described what he believes is occurring at deep-sea vents, i.e.:

" ... those conditions that existed then exist now."

The incredible set of circumstances that had enabled Lewis Flint's discovery of the principles of hydration – what must be considered “the secret code of the universe” – were substantially documented in his 1964 book, *Behavior Patterns of Hydration*, and exposed in footnotes of his original 1932 *Journal of the Washington Academy Sciences* articles on the subject. As further summarized in Flint's subsequent 1973 book, *Dissenting Ape*:

“Had it not been for the stock market crash of 1929 I would not have been loaned out [by one US government office to another] and assigned to research involving electrical measurements. Had I not been curious about the significance of what I was doing I would not have become interested in the behavior of the K, Na, and Li ions in an electrical field. Had I not been abstracting French and German articles for Biological Abstracts I would not have been reading an article in a German periodical in the library. Had I not been studying the behavior of the K, Na, and Li ions at the time, I would not have paid any attention to the article entitled "Electro-Affinity—a New Force in Chemistry [Abegg & Bodlander, 1899]," which dealt with the hydration of the ions K, Na, and Li. Finally, had I been a chemist I would in all probability never have had the nerve to project a description of hydrational potentiality so vitally at variance with concepts long held and revered as factual in chemical science.”

Apparently, this German article had sent Flint back to his 1915 *Principles of General Physiology* textbook by W.M. Bayliss (presumably carried over from his Harvard graduate school studies) to review data concerning the K⁺, Na⁺, and Li⁺ ions. Here were listed conductivity

measurements by Nernst, and on a consecutive page, proposed hydration numbers by Bousfield (which seemingly-essential data would be missing from the next edition of Bayliss's textbook!).

Unlikely as might be considered the essential sequence of events underlying and enabling Flint's great discovery, my pathway to the very consideration of Flint's great work seems equally if not even moreso serendipitous. While living in the seaside community of Venice in southern California, I had been developing strap-on roller skates with polyethylene wheels, and intending to write an article on the history of outdoor roller-skating. A test ride of my latest prototype through the center of "town" was obstructed by a small convoy of big trucks with ground-shaking vibrators extended down from their bottoms, and from which long strings of wires with regularly-spaced devices (so-called "geopods") were deployed along the ground. The trucks set off vibrations that felt like little earthquakes. Inquiring as to their purpose, a worker responded, "Listening for oil".

Coincidentally, long afterward I encountered a 1980 *Scientific American* article which discussed the possibility of the existence of unlimited resources of oil and gas, particularly natural gas. The article summarized the mounting evidence that oil and gas deposits around the globe may be natural phenomena of our evolving earth, and not the product of decaying fossils: "Diverse evidence leads us to believe that enormous amounts of natural gas lie deep in the earth, and that if they can be tapped, there would be a source of hydrocarbon fuel that could last for thousands of years." [*Scientific American*, June 1980, "Deep Gas Hypothesis" by Thomas Gold and Steven Soter.]

The confluence of the local oil/gas exploration activities and global implications of the Gold/Soter article diverted my attention through 1981, to the extent time allowed, to considerations of the quantities and origin of "fossil fuels" world-wide. Particularly eye-opening was a local newspaper article, *Evening Outlook*, Jan 29, 1982, page a-4, entitled "Undersea 'petroleum factories' discovered". The article discussed an expedition to superheated hot springs at the bottom of the mile-deep Guaymas Basin, about about 35 miles off the Mexican coastal city of Guaymas in the Gulf of California and 600 miles southeast of San Diego. At these hot springs on the ocean floor, the expedition had discovered what was described as apparently "juvenile" deposits of petroleum

"The expedition also reported finding the largest bacteria ever discovered – about the size of a grain of sand – in huge mattings up to three deep on rocks and the sea floor."

In an attempt to learn more, I visited Scripps Institution at U.C. San Diego in March 1982. There I was able to meet and discuss, with Dr. Harmon Craig, the methane gas that is being emitted from hydrothermal vents on the ocean floor. Dr. Craig told of his conclusions concerning the non-biological ("abiogenic") origin of this methane.

I asked if any of the methane coming from the vents might be reaching the atmosphere.

"No," said Dr. Craig. "It's all being consumed by bugs. ... Billions of bugs outside the vents. Swarms of bugs."

"Bugs?" I asked. "Yes, bugs." he replied. "Bacteria. It must be bacteria." he offered in clarification.

In an other-worldly tone of voice, Dr. Craig described the mushroom-shaped-cloud appearance of a hydrothermal plume as it virtually explodes upward from a vent and spreads laterally as it reaches the density of the surrounding ocean.

These volcanic hot gases, pushing into to the already-totally-compressed waters on the the ocean floor, pose a classic situation of two immovable objects merging, i.e., 10,000 degree gases that cannot be further compressed, being folded into the solid floor of 4 degree water that likewise cannot be further compressed. The inevitable result is that both substances are somehow forcibly dissociated into their respective component parts, ions if you will, and in-so-doing are inverted into a type of bubbles containing the now-dissociated and energetic, vibrating, ions. These "bubbles" seemingly comprise the simplest of one-celled organisms, or bacteria, falling into the ocean floor in mats. Yes, life is evolving on the ocean floor before our very eyes, today as it did billions of years ago.

Following up on April 23, 1982, I was able to reach Sidney Fox at the University of Miami. I asked, "Is the origin of petroleum and origin of life related?"

"I think so" he said.

In a letter, April 27, 1982, Dr. Fox suggested that at the point of origin (possibly pre-existing) proto-amino acids could go toward life or be cooked out into petroleum", this aside from question of the source of these proto-amino acids (i.e., whether these were pre-existing or the result of spontaneous generation).

Dr. Fox's letter provided copies of relevant background information: "Enclosed in a 1957 paper is a suggestion of hydrothermal origins of precursors to life. This is now considerably strengthened by findings in the Galapagos Rift, Spirit Lake, and the East Pacific Rise".

"The complex interfaces are many. The main picture looks like the prebiotic Earth had to have layers of amino acids. In hydrothermal

vents, these could have accumulated. At a reasonable state of cooking, the polymers of amino acids would have formed, been ejected into marine environment (there are some special steps involving formation of basic and acid polymers), and the aggregation of polymer into protocells. This view is documentably ‘generally accepted’ (Follman, *Naturwissenschaften* 69, 75-81; 1982). The portion of amino acids that did not go this chemical route, toward life in some cases, would dry out and be decomposed to petroleum.”

[Sidney W. Fox, personal correspondence 27 April 1982; *Journal of Chemical Education*, Vol 34, 72, Oct. 1957; *Reprint of The Fifth World Petroleum Congress*, June 4 1959, Fordham, NY, Sidney W. Fox and G.G. Maier, p. 9, ”The production of petroleum as a by-product of in generation of life deserves consideration.”]

Thus, in some cases, where these bacteria are caught in the upwelling of the emerging hot gases, they are being cooked out by the extreme heat and become another substance – what we call petroleum. And we can begin to consider the possibility that huge petroleum deposits found in various locations around the world are the result of similar or identical such processes under some ancient seas, covered over by various geological processes and the sands of time.

On or about April 23-25, 1982, this phenomenon was discussed with Sol Silverman, the expert at Chevron, via telephone. It was noted that *Petroleum Geology* by Tissot Welte, 1978, p. 131, cited John Hunt of Woods Hole, Mass., as the source of calculations based on the Arrhenius equation for petroleum generation. According to Hunt, oil formed in 25 million years at 110 degrees C would take 50 million years at 90 degrees C. Conversely this same oil would form in 24,414 years at 210 degrees C, 24 years at 310 degrees C, 1 ½ years at 350 degrees C, and 17 days at 400 degrees C. As I recall, when presenting these calculations to Sol Silver, he said “I doubt it would take that long.”

In other words, at the types of extreme temperatures and pressures encountered at the interface of undersea volcanoes and the ocean floor, given the proper mix of ingredients, the generation of generation of oil could be virtually instantaneous.

Regarding these “bubbles”, or bacteria if you will, it is the phenomenon of their coming into existence that motivated this writer to seek an understanding of the generic relation between *biology* and *hydration*, how life’s origin itself seems to be the result of the process of hydration – the process whereby these incredibly-hot gases spewing forth from under-sea volcanoes are somehow folded into the immovable and non-compressible waters on the ocean floor.

It was through Harmon Craig of Scripps, and his wife Valerie, that I had learned of the upcoming May 3-4, 1982, Deep Source Gas Workshop in Morgantown W. Va. This was the impetus for cutting short my (four years') tenure in Venice/Los Angeles. Gathering up whatever financial resources could be raised, arranging for a east-bound drive-away car, packing up what belongings that would fit in the car with my string bass strapped to the roof, I was off into a rare L.A. rain storm – destination Washington, D.C. via Morgantown W. Va. I dropped the bass in Chicago for safe-keeping, hopped a bus from the car-drop-off point in Ohio to Morgantown, W. Va., and checked into the conference.

It seems that almost everyone there (except for me) was either from the oil/gas industry, an academic institution, or the government. It was a pretty technical group, but the essential message concerned the existence of “deep source gas” – how deep was it being found and what was its suspected source – i.e., was it from decaying dinosaurs etc. (so-called “fossil fuels”), or was it “abiogenic”, left over from the earth's formation. It is safe to say that the consensus was that a substantial portion at least was indeed “abiogenic”, and indicative of large, virtually inexhaustible, deposits, but actually this was not the only big take-away from the conference.

The surprise package was the existence of a substance called “methane hydrates”, in huge quantities, underlying the permafrost and offshore regions of the world's oceans. The first acknowledged existence of this substance came from a problem experienced with above-ground transmission lines of natural gas. These had been getting clogged when the natural gas being transmitted contained water, even above the freezing point of water. The combination of water and gas, under pressure, formed this substance, a structure, that formed a solid cage-like (“clathrate”) structure generally containing 23 water units and 6 gas units (there was some variability, but this was the general idea). Of course the simple solution was to keep the gas lines free from water.

Independent of the gas line problem, gas and petroleum exploration programs had more recently identified large deposits of methane hydrates beneath under the permafrost and offshore. The estimates of the quantities of gas that might be contained in these deposits are astronomical – the high estimates, attributed to a Russian, a Mr. Dobrynin, as presented by Dick McIver of Houston TX (and confirmed in telecom a/o May 30, 1983), was 2.7×10^8 TCF. If we calculate for comparison the quantities of air in the atmosphere, assuming a approximate 10-mile thick blanket air surrounding the earth, there would be four times as much methane in hydrates as there as air in the atmosphere.

[Dobrynin, VM, et al., “Gas Hydrates – One of the Possible Energy Sources”, Preprints from the IASA Conference on Conventional and Unconventional World Natural Gas Resources, 4th Conference, Montreal, Canada (1979)]

Moreover, these huge deposits of methane hydrates may (indeed probably) serve as caps for huge quantities of gas trapped beneath them. Indeed, rather than looking at natural gas as an inexhaustible natural resource for exploitation, it was looking more and more like gas itself was a geological “fact of life” of the earth itself. “Solid, ice-like mixtures of natural gas and water have been found immobilized in rocks beneath the permafrost in Arctic basins and in muds under deep water along the continental margins of the Americas. While these unusual compounds have been known and studied by chemists for over a century and a half and by gas transmission engineers for the past 50 years, the discovery of natural occurrences came as a surprise to earth scientists.

...

“Hydrates are solid ... and may even form seals and traps that will trap free gas where the structure and stratigraphy of the rocks themselves would not.”

[From Rodney Molone, I learned of a recent workshop on this subject and was able to obtain a copy of DOE/METC 82-49 Methane Hydrates Workshop Technical Proceedings March 29-30, 1982, “The Occurrence and Magnitude of Methane-Hydrate Accumulations by R.E. Zielinski and R.D. McIver]

At the end of the conference I was able to hitch a ride to Washington, DC, and my “home away from home” for the next year and a half, the Library of Congress. Once there I found a title in the card catalog that fit my search criteria, the terms “*hydration*” and “*biology*”, in Flint’s 1968 book *Hydration and Biology*. This led to Flint’s earlier book, *Behavior Patterns of Hydration*, which authoritatively established that Flint had indeed uncovered the “holy grail”. In his words: .

“At the time of the discovery in 1932 I had attained the age of 39, an age held and maintained by no less an authority than Jack Benny to represent the very peak of perfection in a human male.” L. Flint, *Behavior Patterns of Hydration*, 1964.

This current volume, *Hydration and Biology*, explores further physiological implications of Flint’s discovery, providing particularly-detailed long-standing experiments involving osmosis. Here we begin to probe the magic that enables the miracle of life to be expressed in its various forms. In this Foreword are pointed out some associated and notably-broad other implications:

(A) Ponce de Leon's Fabled Fountain of Youth highlights the potential power of Flint's methodology relative to life's processes.

(B) "Beam me up Scotty" suggests the potential of the realization of a four-dimensional algebraic calculable universe.

(C) Prout's Hypothesis Reborn points out how Flint's work establishes the validity of Prout's hypothesis that all elements are composites of a basic one.

(D) Relations Between Periodicities of Mendeleev and Flint – Mathematical & Structural:

(1) Mathematical – Law of Gravitation on the Ionic Level illustrates how Mendeleev's periodicity is apparently based on ionic weight, or gravitation.

(2) Structural – A Combined Periodic Table of Elements, incorporating Mendeleev and Flint's taxonomies, reveals inherent underlying symmetries.

(A) Ponce de Leon's Fabled Fountain of Youth

Flint's experiments involving osmotic measurements provided not only a wealth of validating data, but thereby provided the framework for further extension of related studies into biology, as emphasized in this volume. As independently emphasized by Gilbert Ling, it is only through an understanding of osmotic force can we come to understand the mechanism behind the mechanical force of movement that makes the plant and animal world possible.

Some indication of the significance of this line of inquiry is evident in some excerpts from Gilbert N. Ling's *In Search of the Chemical Basis of Life*, in which he states the "...conclusion that the widely accepted membrane pump theory of the living cell is incorrect." [p. xxvi] ... Ling discusses an approach "wherein the contractile force depends on an osmotic gradient... How precisely this water activity reduction affects contraction is not known and may prove to be a fruitful area for future research." [p. 572]

Gilbert Ling: "How is [the] potential energy trapped in the resting muscle made to perform mechanical work? ... it is postulated that localized changes in the osmotic activity of water (concomitant with the release of K⁺ ions in one area and depolarization of water in another) provide the major force for muscle contraction." [p. 582-584]

As noted throughout the work of Lewis Flint, this is not a replay, but a new tool for truly beginning to understand the source of energy in metabolism; call it the "mathematics of metabolism". At the same time

Flint emphasized that the suggested lines of inquiry that he explored are not in and of themselves definitive. Rather, they are merely a starting point, or starting points, for further exploration.

Given the recent and accelerating strides in our abilities to assess great quantities of data through tremendous advances in computing capabilities, the possibility of taking the simple algebraic foundation uncovered by Flint to near-unimaginable places is truly mind-boggling.

If comprehensible and algebraically calculable osmotic force is the essential force that powers life's processes, then we are faced with the likelihood, not merely the possibility, of attaining the ability to gain a far greater degree of control over these processes than previously imagined, other than in science fiction stories. If life's processes are merely some combination of algebraically calculable electro-chemical changes, the prospect of even reversing such processes, e.g. processes of aging and disease, through a reversal of these electro-chemical changes seems not so impossible, or even nearly within grasp.

(B) "Beam me up Scotty"

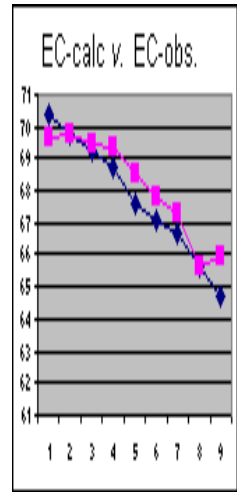
A memorable line from a contemporary futuristic show, "Beam me up Scotty" may find its algebraic foundation in a merger of Flint's and Moseley's respective works relative to the atomic number. At a minimum, Flint's juxtaposition of atomic number versus electrical conductivity may be viewed as an independent confirmation of Moseley's landmark work.

Moseley established that the atomic number varies with the square-root of the frequency of vibration, or inversely with the square-root of wavelength. Flint showed how solute ionic number (+ valence) varies with the inverse square of conductance, which seems to be doing somewhat of the same thing from a different direction, i.e., validating the primacy of the atomic number. At the same time, the overall scheme establishes some precise and definite correlation between conductance and frequency, i.e., wavelength varies with conductance to the fourth power, i.e. a four-dimensional correlation wherein the atomic number is sandwiched between inverse squares.. This may be readily illustrated in tabular form:

Table 1

	Valence	Calc.Cond.			
WL	C	EC-calc	EC-obs	Error	
		545.3/sqrt: (81/sqrt:WL) +7.5+C)			
La	2.676	3	70.388783	69.7	-0.00979
Ce	2.567	3	69.786526	69.8	0.000193
Pr	2.471	3	69.237182	69.5	0.003796
Nd	2.382	3	68.710911	69.4	0.010029
Sm	2.208	3	67.630331	68.5	0.012859
Eu	2.13	3	67.121645	67.8	0.010106
Gd	2.057	3	66.630678	67.3	0.010045
Dy	1.914	3	65.623457	65.6	-0.00036
Er	1.79	3	64.695961	65.9	0.018611

Figure 1



(C) Prout’s Hypothesis Reborn

In 1815 William Prout advanced the hypothesis that the atomic weights of the various elements are exact multiples of the weight of the smallest element, hydrogen. Notwithstanding the painstaking efforts of armies of chemists through the 19th and 20th Centuries, up to the present time, to establish definitive atomic weight values based on relative calculations involving combinations of elements in compounds, conventional chemistry still, even as recently as the year 2014, continues to juggle alternate sets of irregular values for atomic weights.

The work of Flint in particular, in conjunction with a number of other independent perspectives, provides seemingly inconvertible support for the solidity of Prout’s position; Flint's hypothesis of a weight of 4 for H₂ gas on a scale of 32 for O₂ gas* is supported by

(1) similarities with He gas:

(a) He has about 98% the lifting power of H₂** and

(b) an average of less than 4% separates observed diffusion coefficients for He and H₂ in 8 instances affording direct comparison listed in references***;

(2) peculiarities in the behavior of H₂ gas as noted by

(a) Arrhenius, who referred to hydrogen's cathode ray absorption-to-density ratio (5610) as a "notable exception" from the mean [2794=mean for 8 sol- ids (collodium, paper, glass, mica, aluminum, brass, silver, gold) and 3 gases at 760 mm. Hg. (H₂, air, SO₂) as derived by Lenard];

however, when H₂ is assigned a weight of 4 (v.s. 2), its absorption-to-density ratio (2805) correlates closely with this mean****, and

(b) Graham, who commented that the "want of mechanical equivalency in hydrogen mixtures is exceedingly remarkable, being a marked departure from the usual uniformity of gaseous properties"*****; and

(3) previously reported studies involving approximately 200 diffusion coefficients*****

*FLINT, L.H., Behavior Patterns of Hydration (1964), Ch. 11

**CRC Handbook of Chemistry and Physics, 1985-6, B-20.

***CHAPMAN, S., et al, Mathematical Theory of Non-Uniform Gases (1970), 263, 267; and HIRSCHFELDER, J.O., et al., Molecular Theory of Gases and Liquids (1954), 579, 601.

****ARRHENIUS, S., Theories of Chemistry (1907), 91.

*****GRAHAM, THOMAS, Elements of Chemistry (1850), 81.

*****SHAKMAN, SH, Abstracts AAAS, 1986, p. 119 (No. 212).

*****SHAKMAN, SH, Abstracts AAAS, 1987 (No. 110), "Observations of Behavior of H₂ Gas"

(As Newton affirmed, "More is in vain when less will serve."; see also *Principles of Hydration* – Uni-Science abstracts/ associated calculations.)

(D) Relations Between Periodicities of Mendeleev and Flint – Mathematical & Structural

(1) Mathematical – Law of Gravitation on the Ionic Level

In Figure 2, the maximally-hydrated atomic numbers are arranged sequentially, from the smallest (23+0) to the next (22+9; 9 equals the atomic-number-plus-valence-equivalent of the hypothesized negatively-ionized H₂O⁻ ion), and so on. Once so-arranged (in 5 columns), a box is drawn around the ions within each Mendeleev grouping. Therein is seen, as for example, *in each of three Mendeleev Groups (I, II, III, respectively), three ions (with atomic numbers 3, 29, and 55; 4, 30, 56; and 5, 31, 57; resp.) have nearly-identical/consecutive Z'h values* (maximally hydrated atomic number equivalents), i.e., nearly-identical "weight" values. The unlikelihood of such groupings being random suggests a relation between the respective and similar chemical behavior in aqueous solution, i.e. that on which Mendeleev's periodicity is based, and their respective maximally hydrated weights. In other words, this is suggestive of the *action of gravity on the ionic level* as regards the cited ions in respective groupings.

Figure 2: Hydrated Atomic-Number per Flint (Zh) versus --- Mendeleev Periods

Zh (Z)	Zh (Z)	Zh (Z)	Zh (Z)	Zh (Z)
		148 (85)	212 (77)	276 (69)
	85 (67)	149 (59)	213 (51)	----- (V)
	86 (41)	150 (33)	214 (25)	
23 (23)	87 (15)	151 (7)		
	92 (92)	156 (84)	220 (76)	
	93 (66)	157 (58)	221 (50)	----- (IV)
	94 (40)	158 (32)	222 (24)	
31 (22)	95 (14)	159 (6)		
	100 (91)	164 (83)	228 (75)	
	101 (65)	165 (57)	229 (49)	----- (III)
	102 (39)	166 (31)	230 (23)	
39 (21)	103 (13)	167 (5)		
	108 (90)	172 (82)	236 (74)	
	109 (64)	173 (56)	237 (48)	----- (II)
46 (46)	110 (38)	174 (30)		
47 (20)	111 (12)	175 (4)		
	116 (89)	180 (81)	244 (73)	
	117 (63)	181 (55)	245 (47)	----- (I)
54 (45)	118 (37)	182 (29)		
55 (19)	119 (11)	183 (3)		
	124 (88)	188 (80)	252 (72)	
	125 (62)	189 (54)	253 (46)	
62 (44)	126 (36)	190 (28)		
63 (18)	127 (10)	191 (2)		----- (0)
	132 (87)	196 (79)	260 (71)	
69 (69)	133 (61)	197 (53)		----- (VII)
70 (43)	134 (35)	198 (27)		
71 (17)	135 (9)	199 (1)		
	140 (86)	204 (78)	268 (70)	
77 (68)	141 (60)	205 (52)		----- (VI)
78 (42)	142 (34)	206 (26)		
79 (16)	143 (8)	207 (0)		

Z = Atomic number; Zh = Z+9Hmax; Hmax = 23n-Z, and n=1 when Z= 0-23, n=2 when Z=23-46, n=3 when 46-69, and n=4 when z=69-92.

[Note: Above calculations assume neutral values for unhydrated atoms.]

(2) Structural – Combined Periodic Table of Elements, Mendeleev/ Flint

This combined periodic table of elements* preserves essential information of both taxonomies and may facilitate approaching scientific information from the (alternate or complementary) perspective of either.

The utility of Flint's taxonomy serves to emphasize the significance of atomic number as a “more fundamentally important property of an element than its atomic weight” [J.C. Speakman, 1947]. Here, atomic number (rather than atomic weight) is utilized as a measure of relative weight. This combined table of elements

(a) may further be seen to relate to origins of Mendeleev's periodicity in its symmetrical embodiment of the non-metals and the otherwise somewhat anonymous lanthanides & actinides;

(b) may be viewed as geometrically harmonious with the work of R.B.Fuller; and

(c) constitutes a proposed extension/merger of conventionally-appraised periodicities into an encompassing algebraically-structured system which underlies the fabric of the ponderable universe. The existence of such a system was anticipated by both I.Newton** & A.Einstein***

*SHAKMAN,S.H., Proceedings,Pac.Div.AAAS,Vol.6,Part 1,p.39.

NEWTON,Principia(1687). *EINSTEIN,Relativity(1956)

Figure 3

Mendeleev Groups overlaid on Flint Periods. S.H.SHAKMAN

