On The Development of a Social Physics: by Arthur Iberall; retired from UCLA, in part from UC Irvine

Introduction

It is assumable that quite a number of you – present at the ISCSC meeting in Jamaica in 2002 – have at least glanced through the articles I (I.) have (has) written, some in collaboration with colleague Dave Wilkinson (W.). A few of you may even be aware of the fact that I. came to the first organizing meeting for the society's American rebirth from its original European startup (by historian Toynbee and sociologist Sorokin). It had become moribund and our societal member, Roger Wescott (now deceased) had asked and received permission to bring it to America. I. was the only physical scientist present, and the only one who has continued to come. Why? Because in the government sponsored work that I. has been doing in his small R and D company under contract from the early 1950s on, he had reached a rather general intellectual platform of study as a book in 1972 (*Toward a General Science of Viable Systems*). Then, having gotten what was a one paragraph contract, summarizable as "Develop a science of social systems", a first product was a final introductory report in May 1973 entitles "*Toward a General Science of Man Systems, A Venture into Social Physics: Beginnings*" (437 pp.). Although, as it were in one sense, I. was a 'good if not great' long distance runner, he had to do it in sprint style. Where might I. acquire a broad base of information and knowledge for social science under which he could develop an interdisciplinary physical science. Shopping around for a few years at AAAS meetings, I. stumbled on what became ISCSC. It struck him that the range of disciplines he found assembled, particularly wrapped around Toynbee at its inauguration and its next meeting, might have use. For instance, with T. about science and civilization before he died was an interesting dialogue.

It seemed clear at the organizing meeting that Loren Eiseley was lobbying to become to become president. I. found that very encouraging, but it quickly became clearer that Ben Nelson, a classmate of his from CCNY, had the group's vote behind him. It is interesting to speculate how different the society might have turned out under Eiseley.

This is a one page outline: of what of what goes into the content of normal physics compared with what I. believe to be the progression of ideas by which humans have reached nearly to the point that a social physics might have some use; of what I. has written for the society and civilization study in his publications; of the progression of major publications and ideas in his writings; of some of the predictions I. has made by use of his social physics; and of some questions that you or I. think require further clarification or discussion by him.

1. Content of normal physics compared with that for social physics – an outline

* At any level of organization for mechanical units, a feasible beginning attack is achieved by Newton's second law of motion that many people have heard expresses by the 'formula' relating force, mass, and acceleration, $F = m\ a$. Since the units contain mass – if the numerical value of all their interactions are significant in measure (as compared to some small remnant measure which is assignable to what may be called noise) – Newtonian mechanics is appropriate (even for human social action) but only if other levels exist which are capable of balancing in or out flow of three mass-related measures called mass itself, momentum and energy. Many people can state Einstein's law, as one case for this property, $E = m\ C^2$, (energy, mass, speed of light), but we are also thinking of food energy, whether coming from inside or outside. There is also a flow of momentum which can be transported from below or from above. In all these cases, Newton's law is a useful component of motion and change.

* It is known that systems connect level to level (since the 20th Century) from bottom to top or top to bottom, e.g., as cosmos, island galaxies (or clusters), intergalactic systems (commonly ordered as hydrogen or dust clouds, stars by bonded pairs, then in decreasing probability as a stellar system of stars or planets or planetisimals bound by the gravitational force that Newton discovered. Besides the hot bodied stars whose cores are in the tens of millions of degrees, and whose surfaces and whose surfaces radiate energy perhaps a few thousands of degrees (technically Celsius, but centigrade will do as a measure, approximately), there are bodies whose surface temperatures are colder. It is in some such range that stellar systems involving planets are to be found. On such cold bodies, one may find up to three (or four) states of matter: gas, liquid, or solid (there is a somewhat higher temperature state which is viewed as plasma). Since I. cannot (and doesn't want to) write a technical book on physics in a page, I. can only offer level identifiers very briefly. I. uses the planets in our solar system (our Sun is a star) as a model. Planets like ours possess all three states of 'cold' matter. These are subsystems of our planet. Above a surface, which is condensed liquid and solid, there is gas and vapor (which is evaporated liquid, in our case water). Because of our cosmological physical modeling, we know that planets may last a long time, commonly measured in the billions of years (Gy). Therefore, we know that the surface material ingredients turn over. Effectively as much goes up as comes down. Newton's laws of mechanics remain a significant component of planetary surface and near surface motions and changes. Thus, for example, the surface is marked by a chemistry similar among all its cold regions. In recent times physics has developed the technique of very fast crossing of material beams to determine the temporal 'mechanics' of the chemical processes taking place. This is like slow motion pictures in concept. From quite ancient times, a theory of animism was conjectured, namely there seemed to be some sort of action at a distance, possibly produced by internal spirits. That ultimately turned into the pre-chemistry of alchemy, in which four major spirits existed – fire, earth, water, and matter. By about 2500 years ago (Thales to Aristotle, in Greek civilization) a doctrine closer to science in a modern sense began. That can be referred to as an atomism or atomistic doctrine (see, Toulmin and Goodfield, *Architecture of Matter*). By the 19th Century an ordered array of atoms began to form and be built on Newton's end-of-17th Century–notion of force as that agent which could change the state of motion. In addition to the gravitational force, the electric force also was found and accepted. Chemistry thereby emerged, built upon the electrical force in atoms. The atoms were arrayed in ordered atomic number from I on to a hundred or so, by rules involving their relative mass where hydrogen (symbol H), the first elementary atom was numbered with a relative mass near 1, the next, of ordered number 2, Helium (He) has a relative mass number near 4 (approximately the square of its ordering number). This is because the atom is made up of small electrified particles called electrons, whish are assigned the basic electric charge of 1 unit, which orbit around a very compact near-spherical body, a so-called nucleus, made up largely of heavier, almost equal mass protons each with the same unit measure number of electrical charges as the electron but opposite sign (note the electro-physical rule for electrified particles in a simple description – like signs repel and unlike signs attract; their law of interaction is called an inverse square law; the force between particles fall off with the square of the distance between each pair) and electrically neutral neutrons. While the number of protons in the nucleus represents the atomic number, the relative atomic mass does not grow precisely as the square of the proton number. For example, if the atomic number (A) is 1, its relative atomic mass (Z) is 1.008; if A=2, Z = 4.0026; if A = 8, Z= 16; if A = 16, Z = 32.06; if A = 64, Z = 157,5; if A = 92, Z=238.0. There are atomic units beyond, but they no longer have any temporal stability. They are radioactive and are very quickly evanescent. That time is measures as a half life – each unit of existence is reduced in half each such time. Why does I. provide such detailing for atomic atomisms? For a number of fundamental reasons. The numbers sound good here but not too precise. How come? Because there is one more fundamental force besides the gravitational and the electrical. There is also the strong nuclear force wherein proton-neutron couplings in the nucleus are bound (we skip a composite electroweak force). These three are all we know that hold the nuclear structure together. Also with that third force we can determine what isotopes are possible and what isotopes (example a nucleus of 1 proton and I neutron, or 1 proton and 2 neutrons) are stable with long life, and those that die quickly, and why there is no island of stability beyond A = 92. And for a 4th important reason, the existence of some long lived radioactive atoms is required both fot the life and death of our planet and life itself on our planet (that the process is also responsible for the precision process of contributing both atomic reactors and atom and nuclear bombs, by either fission or fusion is perhaps part of both the pride and shame of physics. Not simply digressional, this is not a bad point to examine Eiseley's book on *The Firmament of Time* and to have corresponded with Toynbee on history and

science to believe in some connection among us three about science and philosophy themes of interest to the ISCSC). To provide the civilizationist reader with some idea of what these three forces tend to produce in structure and function, the gravitational force, the weakest one, produces the large scale structures and much of their function; the very lowest structures are quite considerably furnished by the strong nuclear force; and the detailing of the middle structures and functions are very largely governed by the electric force. For a surprising concatination, the electrical force without matter, what we call photons just of light-like energy, interacts with the mass-like content of atoms which are electrically governed (with the strong nuclear force also involved), that creates the chemistry with which we have to be concerned in organization from interacting atoms (plus molecular arrays of bound atoms, and ions which are molecules and atoms which are stripped of some of their electric units). So for our present purposes, I. can turn back to the surface chemistry on earth. (If you the reader are curious, there is a laboratory and industrial chemistry that tends to use typological empirical reasoning much like the typology that I. objected to among most systems' civilizationists. I. expressed this view from almost the very first meeting he attended. It is why I. has stuck around in the society – to see if he could create a chemical physics base for living and societal matter, including civilizational matter. Children can answer the question of what kind of matter do living systems use? . They can answer, quite appropriately, animal, vegetable, and mineral. It is the transformation of the child's version to a professional version that is of concern here).

The earth's surface chemistry also produces interacting regions in the atmosphere and the solid crust and the hydrosphere. You may wonder how come. The problem is that such a fuller layer perhaps 100 mi. thick in a total diameter of 8,000 miles is a rather thin skin. Within that range, life occupies perhaps 10-15 mi. and modern society and civilization have expanded their use from about 1950 (e.g., I. developed the space suit at the National Bureau of Standards in 1946-1948 for the U. S. Navy, and his Division Chief boss, Hugh Dryden, developed the X series experimental craft which took humans into space by the end of the 1950s, an expansion to a few hundred miles within a few decades. [Hey tourist: Want to buy a ticket to space? At present it is it is class before mass, but the price is beginning to fall rapidly]. So now quickly characterized, the surface layer is filled with the crystalline and amorphous nature in chunks and arrays laid down by many other surface systems but also material released from below the surface by volcanoes and earth-quakes. It has the liquids and salts found in the oceans and subterranean waters. It has the gases and vapors of many layered and interactive components up to where the upper atmosphere and its electric layers turn to nothing, or electrically another plasma-like system. Life forms and interacts as another particulate and stratified layered combination. His colleagues and I. date that process as beginning not too long after our sun and planet started about 4.5 Gya (billions of years ago). We have claim-staked life's origin at about 3.8 Gya, which has now begun to be an accepted number, and we have – rather recently – furnished a theory for such origins. To us, it has required the interaction of gas, liquid, and solid, not the earlier 1950 model of Miller-Urey which adds to Darwin's small warm oceans, and some primitive chemical ingredients, lightning energy, but inadequate production of amino acid concentrations to assemble as protein. Our model includes Woese's (1987) 3 kingdoms for bacterial-like organisms. And below that we come to the atoms-ions-molecules creation by physics and chemical physics – see I.'s 2001 paper in *Ecological Psychology*. Below that are the leptons and quarks that you can examine in popular writings, and below that -- perhaps beyond general relativity – string theory. If you must read about such stuff, I.'s colleague, Harry Soodak, has a 17 page clear introduction which is sound and almost up to date in Yates' *On Self-Organization*, 1989.

* To pass from one level of such mechanical units to a higher level of organization, which accounts separately for how the higher level is maintainable as a mechanical system, the lower level has to transport energy, e.g., by doing work, to or for the higher level. The feasible attack for systems with many units sufficiently interacting in their magnitude can be so viewed.

2. I.'s writings and presentations to the ISCSC

* You will find I.'s writings (with or without Wilkinson, W.) scattered throughout *CCR* or its meetings from 1974 on. Rejected from a first publication for ISCSC after first being accepted for the Bloomington meeting for *Mainsprings* prior to *CCR*, it was published in *General Systems* for 1974 as 'On a Thermodynamic Theory of History'. In 1981, I. presented the honorary guest banquet lecture on his topic, 'Physical principles for the organization of civilizations'. In a 1988 issue of *CCR*, three books are reviewed by I., per W., on an overview theory of civilizations. In 1991, I. and W. gave a physical tutorial on Hord's review of our article in Modelski's book on long cycles. In the Spring 1993 issue of *CCR* W. and I. reached a simple working definition for "culture-civilizations", the precursor to civilizations. Quigley is reviewed (Quigley to Iberall), per Melko, in the 1995 issue of *CCR*. In the Spring 1995 of *CCR*, a time scale of 500 years i demonstrated empirically for culture-civilizations by I. And W. It is followed by Holton's critique of our reductionist physical theory, noting its lack of attention to language and other subjects for a social physics. In the Winter 1997 issue of *CCR*, a paper by I. and W.. "On Understanding Language", is published to deal with Holton's earlier critique. It is preceded by a linking prologue by I. [there are a number of others that I. cannot find. Ask the archivist]

3. Interesting points and progression of ideas

* Here are a few interesting points that I. has learnt from his modeling of living systems'. Of course the concern here is largely with mammals, particularly human, but we seek out as much precise generality as we can. So our first question is what is the strength of the mammal. The answer furnished by I., is that it can do things up to the strength of bone, a very unusual crystalline material. The youth cries out that he can break any wall. But if he has no other tools, he can only do it with hands and feet or teeth and jaws. How did he or she exceed that barrier? We can surmise the answer. In the hominid line of mammals, particularly hominid primates, we come to users of tools, particularly among the genus Homo (our book, here called Foundations) is nearly up to date and section p. 43 covers pertinent material. Or, even better, the *History of Humankind*, a *Foundations for Social and Biological Evolution* book I. reviewed in *CCR*, probes at the currently accepted view that some time near the beginning of either or both Homo habilis and Homo erectus, at a time like 2 million years ago, plus or minus ½ million years, the line of other tool materials was developed. A tool is not self nor outer world. It is an object or system, manipulated between self and outer world to affect change. Putting alloys in brackets, that line passed from bone to stone [obsidian], to copper [bronze], to iron [steel]. Beyond those pure matter systems, system civilizationists are aware that power systems are developed as tools, e.g., water power, steam power, and the like.

4. Continued progression into the internal system

* Continuing with the mammalian surface and internal tissue, the child's doggerel comes to mind of how the ankle bone is connected to the leg bone, leg bone to the thigh bone, etc.? It's all bone and internal tissue. And, in fact, in human mammals, those bones in civilizational practice can be replaced by metal. But, the central pressure has to tend to remain near a 100 mm of Hg mean value. The way that the central heart pressure is achieved is by a wringing motion (like wringing out a cloth). If you wring harder, for example up to 300 mm of Hg, that represents high blood pressure and you are soon a dead mammal. The pressure system in mammals has two stages. Amphibians and fish have only one pressure stage, of about 25-30 mm Hg. There is yet a lower level associated with plant turgor. See *Encyc. Britt.* 1975 ed. Vol. 17: 671-676; Article "Stereotyped Response", Section "Plant movements", Subsection "Turgor movements".

5. Predictions

* Not too long ago, a letter was received from William McNeill which indicated his enjoyment with I.'s writings in *CCR*. Choosing the April 1975 Report "To Develop an Applied Science of Man-Systems, Predictions USA – 1970-2040". I. agrees with Woese's (1983) model of three domains of life (Archaea, Bacteria, and Eucaryota). See Woese, C. R. 1983. The primary lines of descent and the universal ancestor, in *Evolution from Molecules to Man: Darwin's Century Conference*, Cambridge, p. 209-233. Referring to his universal history McNeill's *The Rise of the West*, he

asserts to I. that he is too old to rewrite it. "But perhaps you are not too old to do it". The compliment, by all means, is/was the greatest compliment that I. ever received. He had no desire to undertake the task of rewriting that universal history. However, he can comment on some long time predictions he has made relating to a social physics. In the 1960's, members of Congress were concerned with the fact that the American economy was extractive. This was particularly true in the case of Hubert Humphrey. At his request, working for James Rand II, black sheep sun of H. J. Rand, one of Wild Bill Donovan's crew, Rand was aide-de-camp to four star army-Air Force General Putt. When Putt asked his aide for a suitable name for their soon-to-be-new think tank, Rand immediately snapped out RAND, R and D. This is I.'s apocryphal version of how the Rand Corp. in Santa Monica got its name. I. predicted what the GDP would be in the year 2000. His 40 year prediction was within 4%. En route to the year 2000, the claim was repeated often enough to realize it really was a prediction.

* This is a Cassandra-like prediction that I. made at a long past Olympics: that in the struggle between the Israelis and the Palestinians, there would result world war within less than three generations (70 years). The midpoint of that period is 'now' about 2000 or so. That prediction still teeters on the head of a pin.

* Should this be considered just a fluke guess on my part, I will furnish a much more extensive background. I. was born in NYC in 1918. His mother, Anna, born a Jewish Livonian, attempted to get her niece ,Eva, out of Europe in the early 1920s.. She couldn't get E. admitted to the USA. Instead, she succeeded in getting her niece into Petah Tikva, Palestine. I.'s mother's brother was foolish enough to get off the boat in Glasgow, with four sons, and lived there in a life of poverty, until all the son's disappeared. Over the years, I.'s family corresponded with that niece and her children. Those children, niece's and I.'s, have kept in touch. That has resulted in an unbroken, even if intermittent, contact with Palestine from early 1929 on. (aiberall@uci.edu) (May 2002)