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

Introduction

This note was presented by the author at the 2002 meeting of the International Society for the Comparative Study of Civilizations (ISCSC). It has been slightly edited for clarity.

It is assumable that quite a number of you have glanced through the articles I have written, some in collaboration with Dave Wilkinson, for the ISCSC. Visiting in Europe, Roger Wescott from Drew (now deceased) received permission to bring the society to America from its original European startup (by historian Toynbee and sociologist Sorokin). I came to the first organizing meeting for that rebirth, as the only physical scientist present and the only one who has continued to come. In work sponsored by Government contracts that I was doing in my small R and D company from the 1950s on, I had reached a general platform of study (published in 1972 in *Toward a General Science of Viable Systems*). Getting a one paragraph contract to study social systems by physical principles, a first product was published as a final introductory report in May 1973 entitled *"Toward a General Science of Man Systems, A Venture into Social Physics: Beginnings."* (437 pp). Where might I acquire a broad base of information and knowledge for social science under which I could develop an interdisciplinary physical science? After going to AAAS meetings, I stumbled on what became the ISCSC. It struck me that the range of disciplines assembled there, particularly wrapped around Toynbee at its two inauguration meetings, might have use. Written exchange with him on science and civilization was an interesting dialogue.

This is a condensed outline: 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 have written for the society and civilization study in my publications; of the progression of major publications and ideas in my writings; of some of the predictions I have made by use of my social physics; and of some questions that you and I think require further clarification or discussion.

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 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. There is 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 from bottom to top or vice versa, 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 radiate energy perhaps at a few thousands of degrees, 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 write a technical physics text in a page, I can only offer level identifiers. I use the planets in our solar system as a model. Planets like ours possess all three states of 'cold' matter as subsystems. Above a surface, which is condensed liquid and solid, there is gas and vapor (which is evaporated liquid). 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. 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 wind. By about 2500 years ago, a doctrine closer to science in a modern sense began. That can be referred to as an atomism or atomistic doctrine (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 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 measured as a half life – each unit of existence is reduced in half each such time. Why such detailing for atomic atomisms? For a number of fundamental reasons. The numbers sound good here but not too precise. Why? 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 1 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 4^{th} important reason, the existence of some long lived radioactive atoms is required both for 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 at which 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 concatenation, 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 I attended. It is why I have stuck around in the society – to see if I could create a chemical physics base for living and societal matter, including civilizational matter. Children can answer the question: 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 why. 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. 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. My 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 *Ecological Psychology, 2001).* Below that are the leptons and quarks, and below that -- perhaps beyond general relativity – string theory. (See Harry Soodak's paper in Yates' *On Self-Organization*, 1989 for an interesting start.)

* 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. Writings and presentations to the ISCSC

* A paper, accepted for the Bloomington meeting for *Mainsprings* prior to *Comparative Civilizations Review (CCR)*, was published in *General Systems* for 1974 as 'On a Thermodynamic Theory of History.' In 1981, I presented the honorary guest banquet lecture for the Bloomington meeting on the topic, "Physical principles for the organization of civilizations." In a 1988 issue of *CCR*, I reviewed three books on an overview theory of civilizations. In 1991, Wilkinson and I 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,* we 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*, Wilkinson and I I demonstrated empirically a time scale of 500 years for culture-civilizations. This was 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*, our paper "On Understanding Language," is published to deal with Holton's earlier critique.

3. Interesting points and progression of ideas

* Here are a few interesting points that I have learned from my modeling of living systems'. The concern here is largely with mammals, particularly human, but we seek out as much precise generality as we can. Our first question regards the strength of the mammal. The mammal 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 or she has no other tools, it can only be done with hands and feet or teeth and jaws. In the hominid line of mammals, particularly hominid primates, we come to users of tools, particularly among the genus Homo (see *Foundations for Social and Biological Evolution*). The book, *History of Humankind*, 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 and baked clay], 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 doggerel comes to mind of how the ankle bone is connected to the leg bone. It's all bone and internal tissue. And, in fact, in human mammals, those bones in civilizations' practice can be replaced by metal. But, the central pressure has to tend to remain near a 100 mm of Hg mean value. Central heart pressure is achieved by a wringing motion. Wringing harder, for example up to 300 mm of Hg, 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 of about 25-30 mm Hg. There is yet a lower level associated with plant turgor (*Encyc. Britt.* 1975 ed. Vol. 17: 671-676; Article "Stereotyped Response", Section "Plant movements" with a plant turgor subsection following.)

5. Predictions

* Not long ago, a letter was received from William McNeill which indicated his enjoyment with my writings in *CCR*. Examining my April 1975 Report "To Develop an Applied Science of Man-Systems, Predictions USA – 1970-2040," the reader will readily note the importance of McNeill's majestic universal history *The Rise of the West* Besides making great use of his work in my April 1975 report, it also served very significantly – beyond its historical merit – in helping to lead me towards my social physics study and its three decades of development. McNeill also commented to me that probably his book needed rewriting, but that he was too old to do it. "But perhaps you are not too old to do it". The compliment is the greatest compliment I have ever received, but I simply do not have the remaining life time to do it and the other tasks that I have to get done. ISCSC members are supposed to be able to assay such tasks. Adding now another - biological – subject, I agree with Woese's (1983) model of three domains of life (Archaea, Bacteria, and Eucaryota). He has identified the primary lines of descent and the universal ancestor, in *Evolution from Molecules to Man: Darwin's Century Conference*, Cambridge, p. 209-233. As one more – here social – subject, 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 Humphrey's request, when I was working for James Rand II, who was one of Wild Bill Donovan's crew, I estimated what the GDP would be in the year 2000. By accounting for the absolutely necessary compartmental functions in Government (e.g. defense, transportation, etc., about 10 in all), my 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. (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 my apocryphal version of how the Rand Corp got its name).

* This terminal note is a Cassandra-like prediction I made at a long past Olympics: that in the struggle between the Israelis and the Palestinians, there might be a 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. I can make such a prediction because my family background, from mother on, has had early contact with Palestine from about 1929 so that from such a very early on period, I have a considerable continuous knowledge base of Palestine.

(aiberall@uci.edu) (July 2002)