The Globalization of the World Systems with Sequences of their Power Structures

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Mapping Change over Time

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My responsibility for this workshop is to prepare a short paper on a substantive topic that invites (a) visualization by technical methods of mapping temporal evolution, and/or (b) time-series analysis.

I propose to do this by showing the group some data which I have collected, presented and analyzed in fairly straightforward ways, but which seem to me to beg for more sophisticated methods than I am ready, willing and able to apply, since my commitments for the near future lie more in the making of new data than in the exploitation of what has already been collected.

I have for some years been working on developing data and, to a much lesser extent, testing theory concerning the political structures, the power configurations, of civilizations or "world systems," exploring typologies for such structures, locating the sequences of such configurations over very long durations, developing and testing hypotheses about the expected succession of such sequences.

I have elected two topics for this workshop: the globalization of the world systems, and the sequences of their power structures. Both topics have associated datasets. The data on first topic--the spatial and temporal paths which the several autonomous civilizations or world systems of the past took as they grew, collided, and fused to become the single world system of today's global civilization--seems to me to demand better visualization immediately, but then will need considerably more data before it invites technical analysis.

The data on the second topic--the sequences of power configurations within the several world systems of the distant past, and within the single world system of the present and the recent past--seem to me, on the contrary, to beg technical analysis, though they too might be usefully re-visualized.

At this point let me draw your attention to Figure 1.

Figure 1, "The Incorporation of Twelve Civilizations into One"

Jan. 18. 2004 4:01PM FIGURE 1 No. 2369 P. 9/16

The Incorporation of Twelve Civilizations Into One

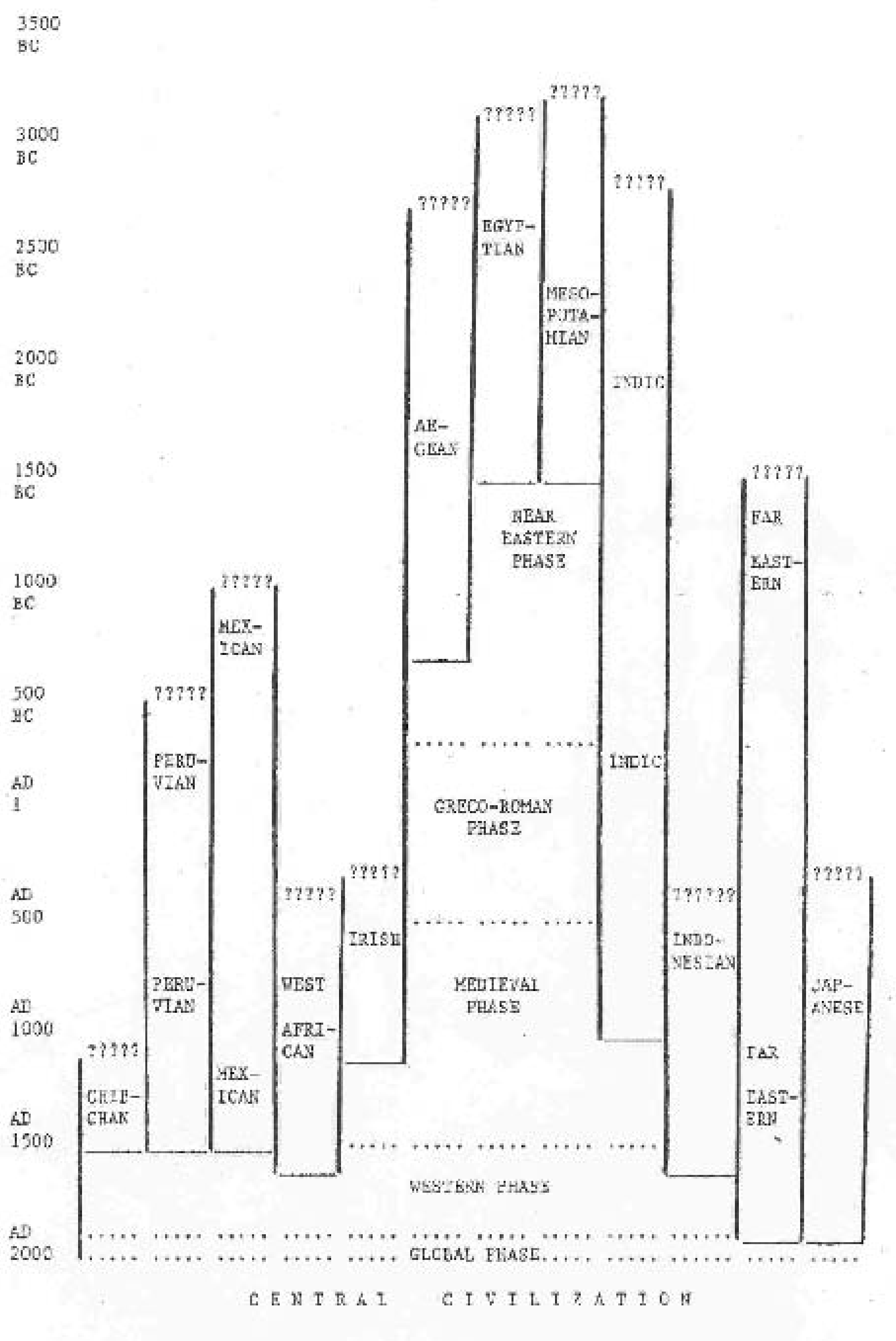


Figure 1 dates from 1984 and the era of the typewriter; it is a software-free time chart which begins at the top of the page. As one goes down the page and forward in time, civilizations or world systems come into existence at various moments in time and points in space, coexist for some duration, then merge into larger entities.

While this figure shows with reasonable clarity what is meant by the merging of many systems into one, it has certain deficiencies which a superior graphing software could perhaps correct.

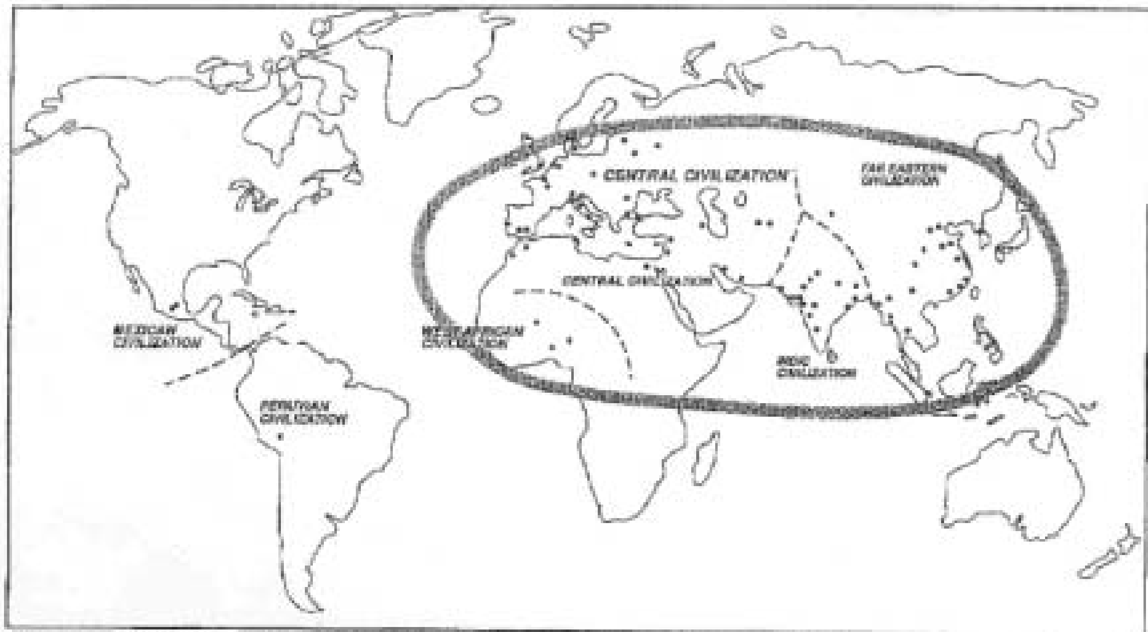
(1) All column sizes are the same, in some sense suggesting equal sizes for all systems at all times except the merged Central system. This is of course not the case, whether we speak of size in terms of area, of population, or of city numbers. This deficiency can be obviated when and if the changing sizes of civilizations could be easily graphed by software which would input a number and turn it into a columnar width.

The input might be, e.g., the number of large cities, or the civilizational area in square miles, or a population estimate for the whole civilization--more likely logarithmic magnitudes for both the latter, to hedge against pseudoprecision, or city numbers).

Preliminary data for such input exist, or could perhaps be derived via GIS. A representation of such extant data will be found in Figure 2, which locates, names and assigns to their respective civilizations or world systems 75 cities of the year AD 1500.

Figure 2, "The Old Oikumene and its Civilizations in A.D. 1500"

FIGURE 2



The Old Oikumene and its Civilizations in A.D. 1500

= Area Within the Old Oikumene

• = Largest 75 cities, 50 thousand +, derived from Chandler's list (1987) via Wilkinson (1992-1993).

(2) The columns of Figure 1 are immediately adjacent to one another, suggesting that systems were so adjacent and in touch throughout their durations. This is not the case: the civilizations grew in space, threw out penumbras of trade nets, and were increasingly interrelated until they merged. If some measure of separation or interrelationship (as for instance distance between semiperipheral cities, or number of goods-types known to be traded at a given moment) could be incorporated into a graphic, we could see these entities approach one another over the interval before they merged.

(3) The chart is two-dimensional, and since time is included the north-south spatial dimension is simply ignored, and systems arranged on an east-west dimension, placing say Ireland and Mali as neighbors. If time is to be retained, and a north-south separation included, the graphic will have either to be a hologram or a fairly sophisticated two-dimensional representation.

This is the problem, for me, of the visualization of globalization. I have looked for software which might solve at least the first two problems, in what seemed to me the logical place, namely software for mapping or diagramming river systems, since river basins commonly show streams of different width and changing separation merging in space, which is at least analogous to world systems merging over time. But I have found no simple application that does what I think needs doing, and while there may be complex software that could be put to service, it seems wasteful to learn to pilot a 747 just to make the trip to the corner 7-11.

So here's my first challenge to the technical side: can you find or fabricate graphic software that will allow a superior diagramming of the growth and merger of world systems, by taking numerical input representing the sizes of such systems, and the separations of pairs of such systems at given moments, and interpolating values between the moments? Maybe yes, maybe no; it would be good to know either way.

My second problem has to do with the representation and analysis of the power configurations or political structures of world systems at different moments in their careers. For a preliminary look at what I mean, please examine Figure 3, again from the typewriter era.

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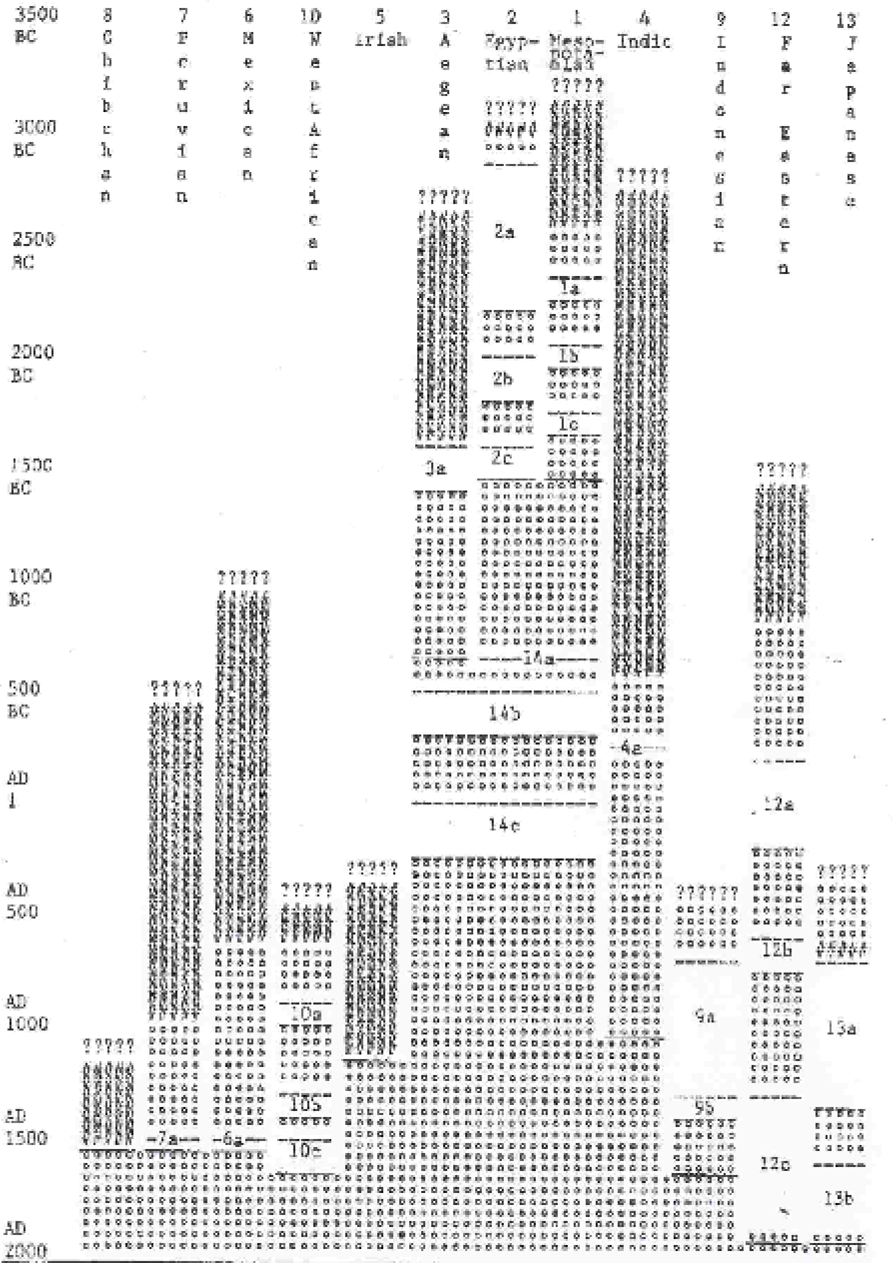
Figure 3 Chronogram of States Systems and Universal Empires



Code numbers refer to civilization and universal empire, e.g. 7a="Peruvian;Inca"
Areas marked "ooo" are judged states-system periods; marked ### are doubtful.

Figure 3 overlays Figure 1 with shadings. The shaded and unshaded areas represent values of a nominal variable treated here as dichotomous, two possible political conditions for a world system: centralization vs. decentralization; universal empire vs. systems of independent states. The variable is an important one theoretically, concerning which there have existed various hypotheses, usually expecting increasing centralization over time, hence a preponderance of circle-shadings toward the top and of unshaded areas toward the bottom. This graphic is useful for showing that this is not at all the case, and that the problem is more complex.

Since producing Figure 3, I have been attempting to deal with the obvious concern that a dichotomous variable--Empire vs. States System--underrepresents intriguing complexities of power structure. For the next step in data collection I elected to try a heptachotomy, a seven-valued nominal power configuration variable, which included configurations long of interest to political scientists and world-systems analysts: in addition to empire, I look for a weaker form of domination, namely hegemony; and among states-systems, I varied the number of great powers, distinguishing unipolarity (with one superpower, as in the world today) from bipolarity (as during the Cold War) from tripolarity (with three great powers), multipolarity (more than three great powers, as in the world system during say 1815-1945), and nonpolarity (no great powers but many small independent states).

Surveying the world systems on this much more complex variable is taking a long time, and I'm far from finishing even a first cut, but I have some results. I provide a sample of these results as Figures 4-7.

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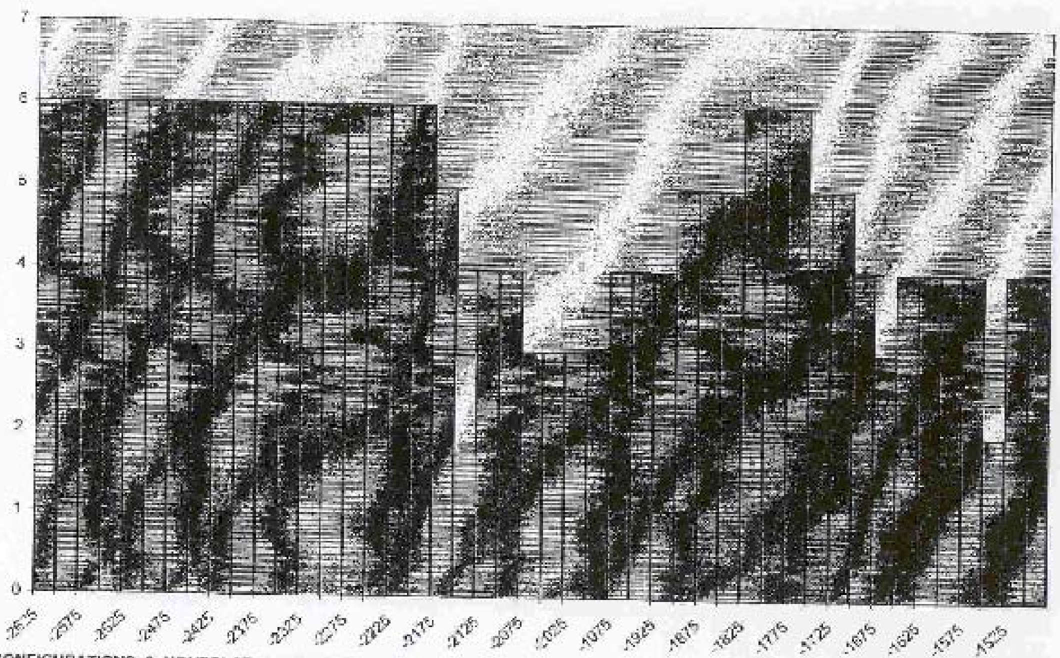
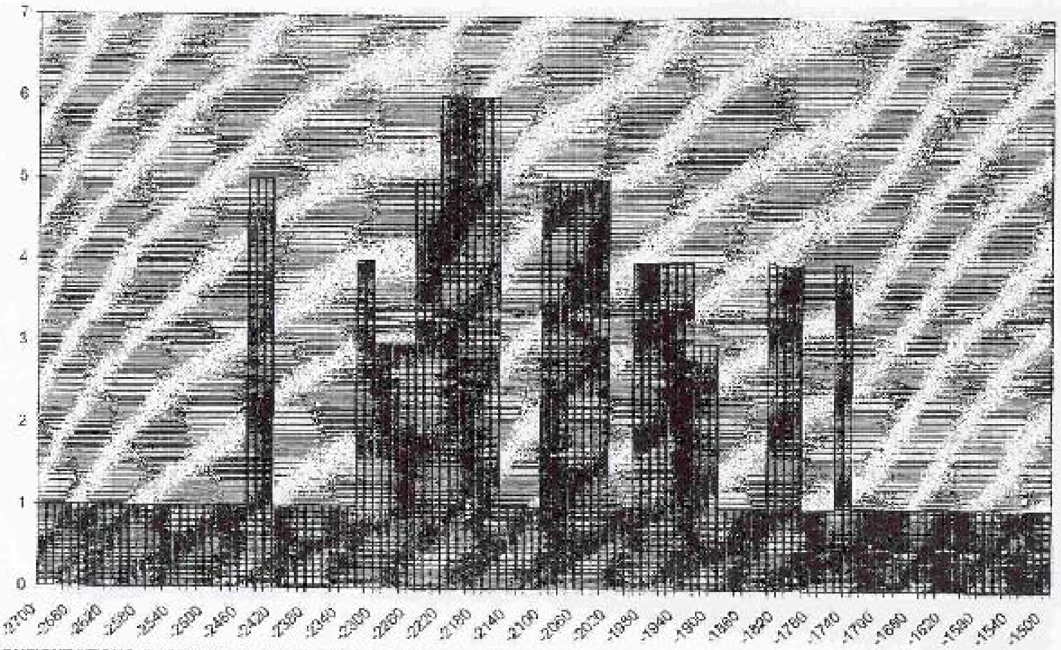
FIGURE 4--NORTH-EAST AFRICA



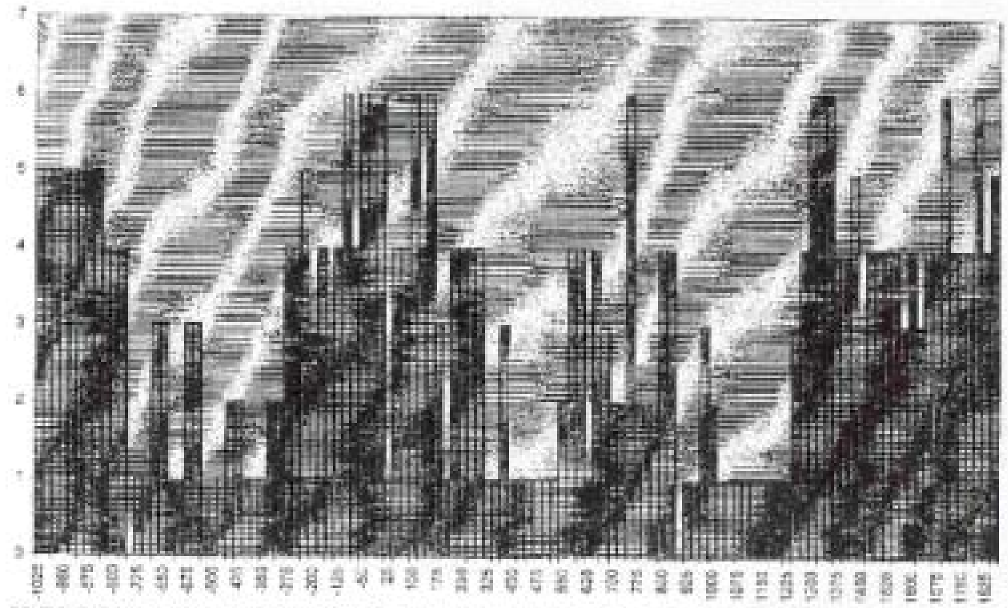
CONFIGURATIONS: 0=NONPOLAR, 1=MULTIPOLAR, 2=TRIPOLAR, 3=BIPOLAR, 4=UNIPOLAR (NONHEGEMONIC), 5=HEGEMONY, 6=EMPIRE

FIGURE 5--SOUTHWEST ASIA

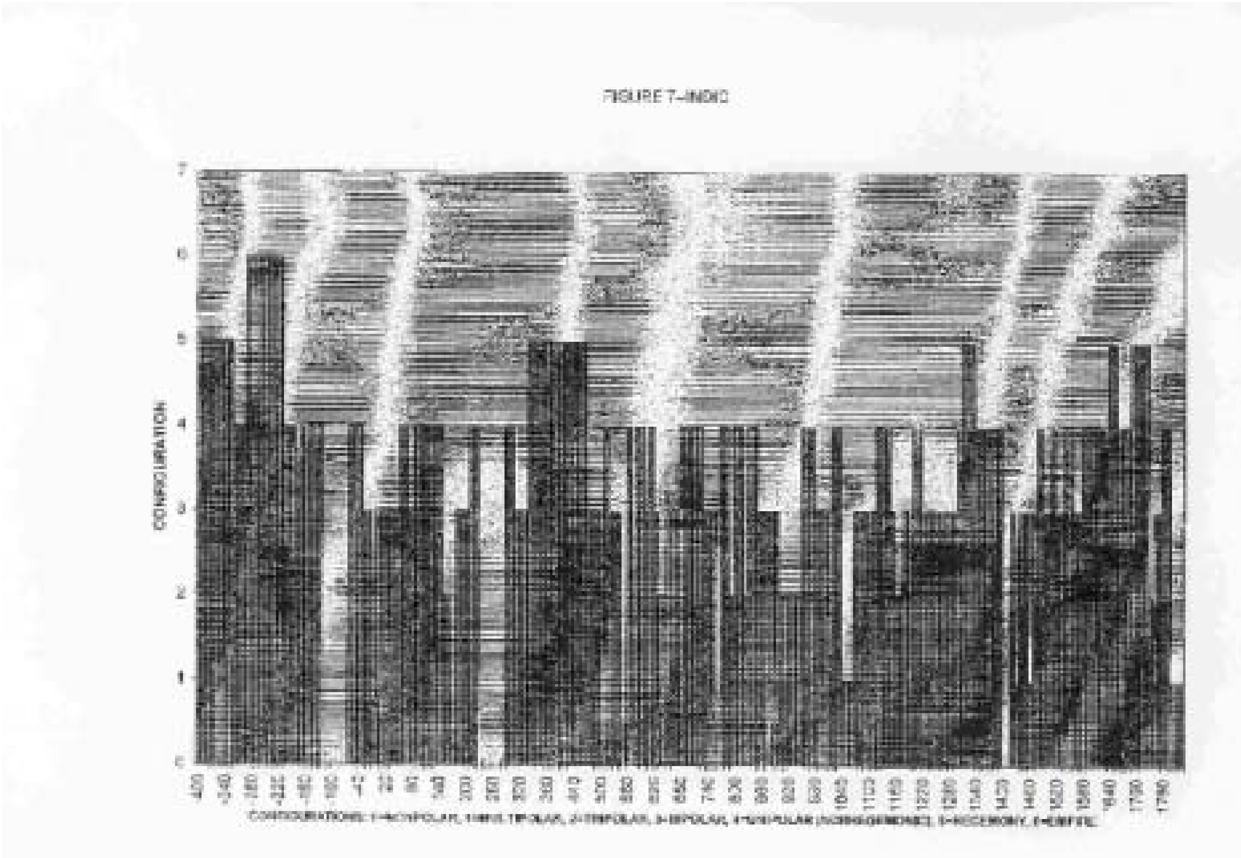


CONFIGURATIONS: 0=NONPOLAR, 1=MULTIPOLAR, 2=TRIPOLAR, 3=BIPOLAR, 4=UNIPOLAR (NONHEGEMONIC), 5=HEGEMONY, 6=EMPIRE

FIGURE 6—FAR EAST



CONFIGURATIONS: 0=NONPOLAR, 1=MULTIPOLAR, 2=TRIPOLAR, 3=BIPOLAR, 4=UNIPOLAR (NONHEGEMONIC), 5=HEGEMONY, 6=EMPIRE



As will be obvious, there is some orderliness here, yet no supreme pattern leaps out at you. So what will be needed is an analysis that tests one hypothesis after another, and builds new ones partly upon the ways and directions in which rejected hypotheses fail, as demonstrated for instance in L.F. Richardson's analysis of the complexity of wars.

Let me state some of the simpler hypotheses which float about the environment, sometimes compatibly with, sometimes contradicting one another.

(1) Systems increase in centralization as they age.
(2) Systems tend to increase in centralization over time, but there are strong short-duration fluctuations enroute.

The data graphed in Figures 4-7 are not at all consistent with either (1) or (2), which reflect the civilizational ideas of Spengler, Toynbee (original) and Melko.

(3) Multipolarity is the norm.
(4) Multipolarity is the stablest configuration.

The notion that multipolarity is the stable norm is represented in an idealized way in Figure 8. Although multipolarism is widely approved by contemporary politicians, it is fairly consistent with only one graph (Figure 5, SW Asia), and even there there are long failure epochs.

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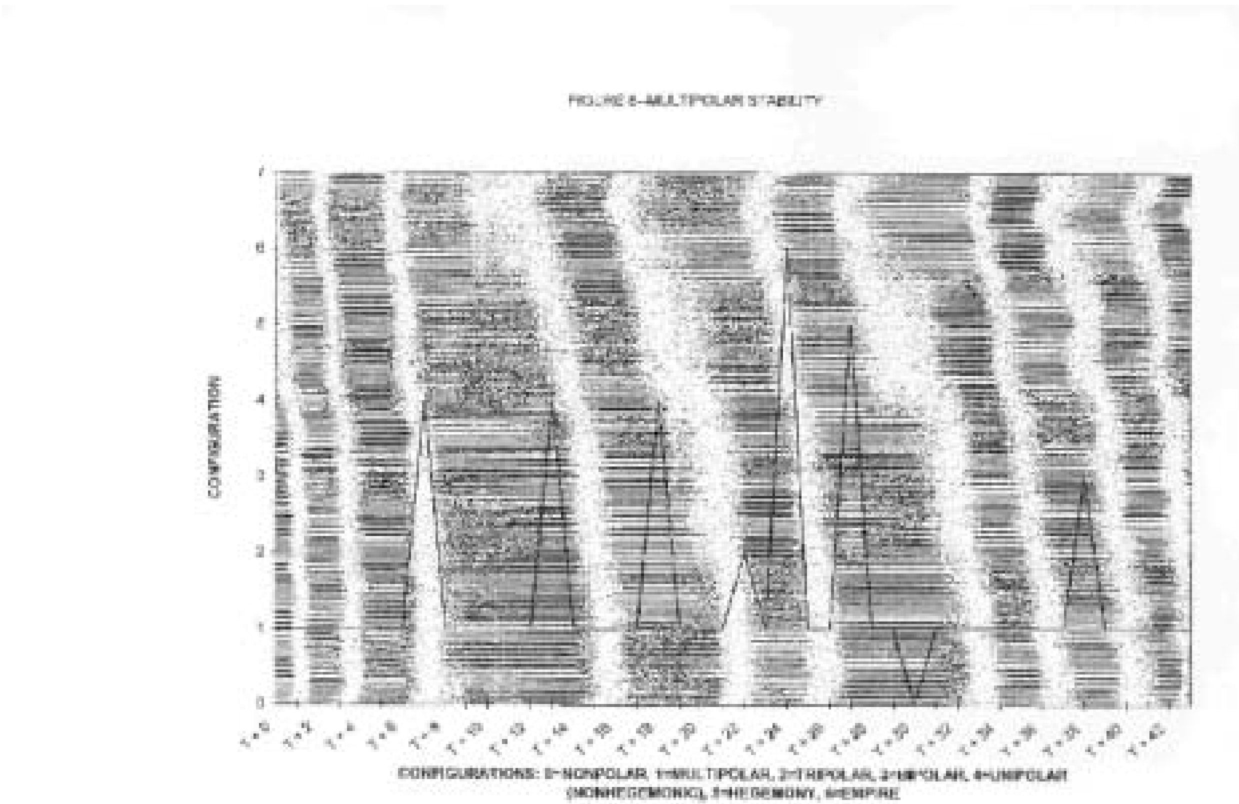
Figure 8, "Multipolar Stability"



(5) Empire is the stablest configuration.

No doubt approved by Sons of Heaven, Caesars and Pharaohs, and certainly by Dante Alighieri, what we might call ultra-imperialism is reasonably consistent with one graph (Figure 4, Northeast Africa), but not the rest.

(6) Bipolarity is more stable than multipolarity.

Particularly identified with Kenneth Waltz, this hypothesis is inconsistent with one graph (Figure 6, Far East), not inconsistent with two graphs (Figures 5, SW Asia, and 7, Indic), and probably not adequately tested in the fourth (Figure 4, Northeast Africa).

(7) Systems begin maximally decentralized, then endure long cycles of increasing and decreasing centralization.

This, the weakest hypothesis of the set, identifiable with the late work of Toynbee (Reconsiderations), seems broadly consistent with all but one graph (Figure 4, Northeast African); still, one would like to know more.

Based on visual inspection of the data, I have elaborated a few more that seem worth a try, and will require more careful testing than the simple, straightforward optical analysis just employed. Two are derivable from ancient and early modern physics, as well as from bureaucratic experience.

(8) Systems are Newtonian-physical, or conservative, and will most likely be found at any time in the same configuration they showed at the time of last measurement.

(9) Systems are Aristotelian-physical, or reactionary, and will most likely be found at any time in the configuration they have occupied for most of their duration.

Another hypothesis might emerge from common network analysis. Two network types seem to have parallels in the power configurations. "Random" networks, with nodes linked at random, lack such a parallel. "Regular" networks, with neighbors highly interconnected, best approximate the Nonpolar configuration. "Scale-free" networks, with a small number of highly connected nodes and a large number of weakly connected nodes, are represented by the other six configurations, with Empire having the smallest number of highly connected nodes, Multipolarity the largest.

(10) A relevant hypothesis might then be: the bigger they are, the harder they fall. A chance of large cascading failures seems inherent in highly interconnected systems when they are stressed: perhaps then transitions out of the Empire configuration will tend toward greater decentralization than those out of the less-connected Hegemony and Unipolarity configurations.

At this point I will stop posing hypotheses and start asking questions, to which I hope somebody in the audience will have answers that may either propose additional hypotheses or means of measurement.

(11) To what extent do these world systems behave according to Zipf's Law? If for each of them we calculate the frequency of occurrence of each of the seven configurations, then logarithmically plot the frequencies in descending order, to the degree that the slope of the plot approximates -1 (vs. 0), the curve may be a "signal" containing information and implying complexity of the underlying system. (A 0 slope would be noise, a signal with no information, attributable to chance.) Zipfian behavior would to some extent seem consistent with "traditionalism," in that the more often a behavior (configuration) was displayed in the past, the more often it would be predicted to occur. But is there more to it than that?

(12) Discussion of Zipfian patterns leads to introducing the--at least to me--difficult notion of Shannon entropy. Verbal descriptions of Shannon entropy, with whose mathematics I am unfamiliar, inform me that zero-order Shannon entropy measures the diversity of a repertoire: in this case, a world system's repertoire would be the number of configurations which are actually displayed by that world system over time. For instance, the repertoire of Northeast Africa excluded nonpolarity, as did that of Southwest asia, which also omitted tripolarity, while all seven configurations appear in the Far eastern and Indic timelines.

First-order Shannon entropy measures the frequency or probability of occurrence of each element in the repertoire. Second-order entropy is a conditional probability: knowing an item in a sequence of configurations, what are the chances of predicting the next item? The third-order entropy value is the probability of predicting the third configuration in a sequence, given the first two. Higher entropy values at given orders, and non-zero high-order Shannon entropies, imply a higher degree of predictability, regularity and form in the whole system.

It might be of interest to calculate the Shannon entropies of the various world systems, and to attempt to interpret them.

(13) It would appear by inspection that the volatility (variance) of power configurations changes over time--compare the first and second halves of the Figure 4 timeline--and perhaps therefore also their Zipfianness and Shannon entropy do so as well. Do any particular configurations or sequences predict higher or lower volatility? But what is an appropriate measure of volatility in a nominal variable?

Hypotheses 8-10, and topics 11-13, I don't feel prepared to undertake alone; I have more pressing business in the datamaking area. Like the task of improving the graphics of Figures 1 and 3, they need more sophisticated tools than I currently possess, which leads me to a search for someone better able than I to deploy same. So my objective at this meeting is to find a collaborator or two who is equipped to rapidly process these data, and other data in the making now, exploring for Zipfianness, Shannon entropy, volatility variation etc., and jointly analyze the findings, and/or to provide superior and more suggestive graphic displays for existins data.

CIVILIZATION/WORLD SYSTEM
POWER CONFIGURATIONS

PHASE I: TWO CONFIGURATIONS

UNIVERSAL EMPIRE
STATES SYSTEM

PHASE II: SEVEN CONFIGURATIONS

EMPIRE
HEGEMONY
UNIPOLARITY
BIPOLARITY
TRIPOLARITY
MULTIPOLARITY
NONPOLARITY