

# Connecting the Dots without Forgetting the Circles<sup>1</sup>

**Alvin W. Wolfe**

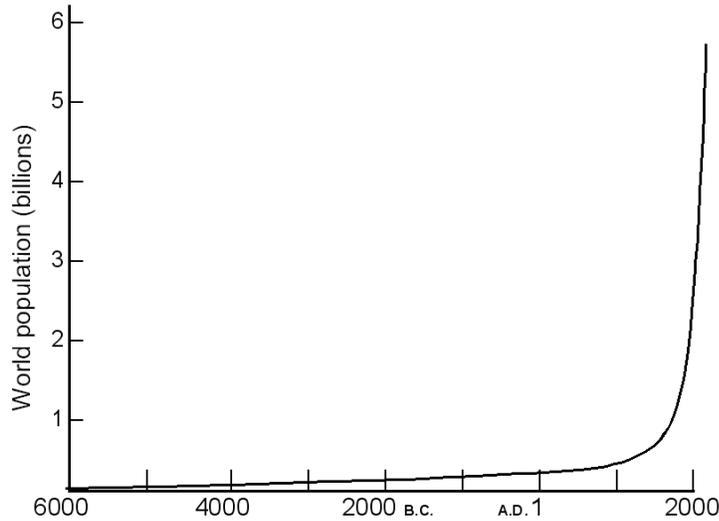
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*The steep slope of the increase in human population over the past century has been accompanied by increased complexity of the various systems that serve the six billion human beings that growth has produced. Network analysis has been a response by social scientists to the necessity to develop better methods of analysis. Now other scientists are finding network models more and more useful for understanding their own fields — in the study of materials from quarks to the cosmos, in the study of biology from DNA to ecosystems, and in the study of humans from domestic networks to the internet. The randomness that was earlier assumed is being questioned at all levels of analysis. We need to step back and review our own culture's ontological conceptions of what is really out there and how it is organized. That can be done properly only in some kind of comparative perspective. Because of its holistic and comparative perspective, anthropology has a role to play. Its interdisciplinary leanings and connections — biological, linguistic, historical, social, cultural and humanistic — are valuable in these times of increasing specialization of scientific enterprises. Judgments, as to what we know and what we do, are based on experience, and experience is interpreted by each of us in terms of our own culture, what we have learned to believe is known. There is much that is yet unknown about connecting the dots and interpreting the circles. Circles — cohesive and structural clusters, domains, and fields — at one level of analysis become dots at higher levels in one of the three major hierarchies of systems and subsystems — in the hierarchy of physical and material systems, in the hierarchy of evolving biological systems, and in the hierarchy of our rapidly developing human social or cultural systems. If we open our minds to the possibilities that can be generated in the interactions among the dots and circles of these systems and subsystems, all of which are relatively open networks, we social scientists may make enormous contributions to understanding the whole.*

The steep slope of the increase in human population over the past century has been accompanied by increased complexity of the various systems that serve the six billion human beings that growth has produced. Figures 1 and 2 illustrate the marked spike in human population after more than a million years of fairly regular growth.

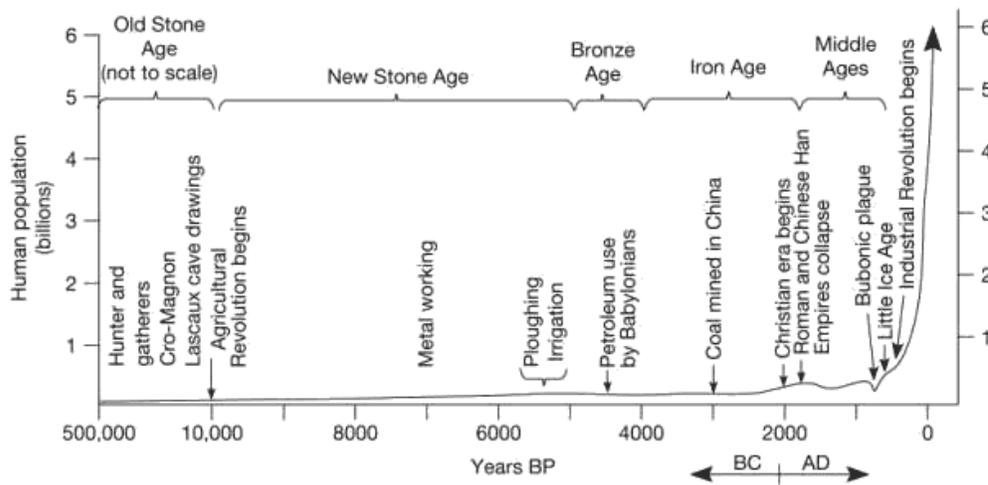
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**Figure 1.** World Population Curve, adapted from Figure 10.4 in *The Natural History of Man*, by Carl Swanson (1973).

Figure 2 points up some of the many notable events that anthropologists find along this timeline: the outstanding art in the Paleolithic Cave paintings, beginnings of pottery making, the origin of agriculture, the invention of metalworking, etc.

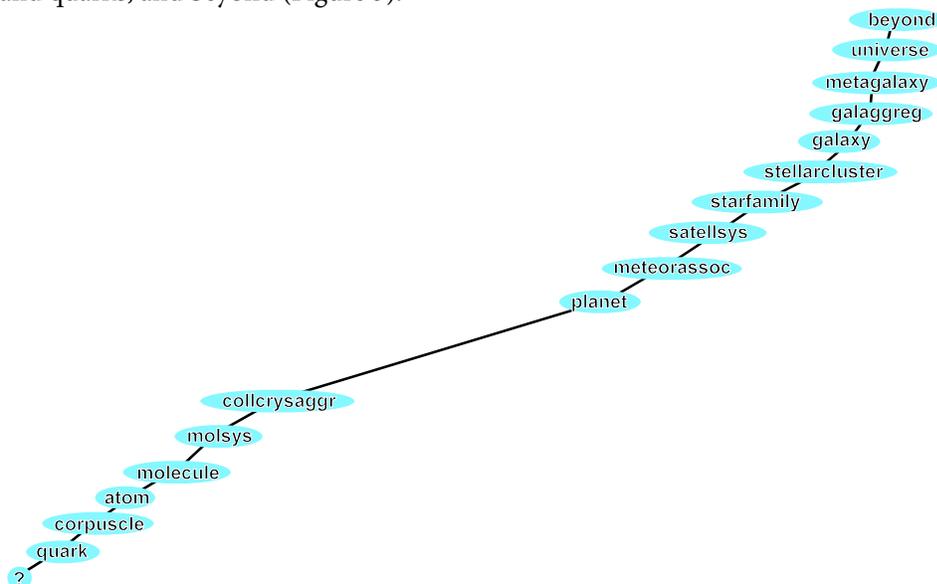


**Figure 2.** Human Population Growth, with Human Events Marked (From Figure 7.1 in Mackenzie, 1998).

The figure reminds us also that anthropologists are interested in so many different things that the field is almost itself “interdisciplinary” — biological anthropology, archaeology, linguistics, and cultural anthropology. Those interests extend to philosophical ideas as well. Anthropologists are interested in our own ideas about the nature of things and in the cosmological ideas of other peoples as well — cross-cultural cosmology.

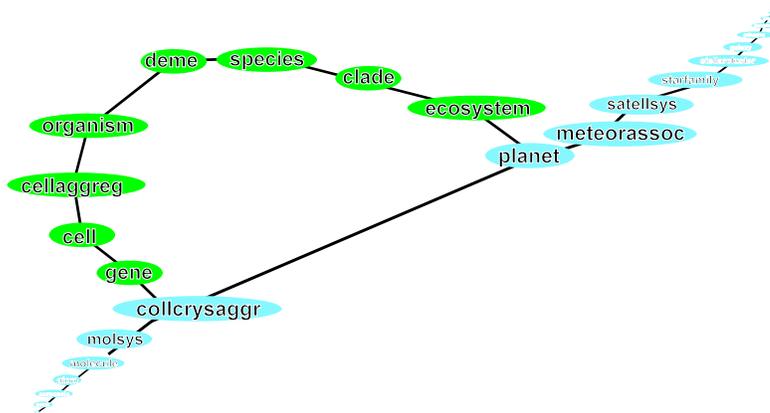
No matter what problem the anthropologist is studying, it can be considered in its broadest relevant context. The four fields of anthropology — physical/biological anthropology, archaeology, linguistics, and social/cultural anthropology involve systems, and thus the systemic whole is relevant. The

scientific view of the physical universe is a set of nested subsystems down to molecules, corpuscles, atoms, and quarks, and beyond (Figure 3).



**Figure 3.** A Hierarchy of Materials Systems. [Note: This figure and all the succeeding ones, except for figure 6, were created using the network drawing program, Krackplot (Krackhardt, et al. 1994)]

There is no question that the material world is hierarchical. If you were a scientist fifty billion years ago this material world is all that you could have known. That is all there was — anywhere. Only very recently did scientists of our kind, the “modern” kind, start understanding it “scientifically,” and that knowledge began with some positive understandings about levels somewhere in the middle of its range, in the area between the crystalloid aggregates and the planets. We have increased our knowledge of material systems in both directions — up and down the hierarchy, using empirical methods wherever possible. The evidence suggests it is constantly expanding — evolving (Figure 4).

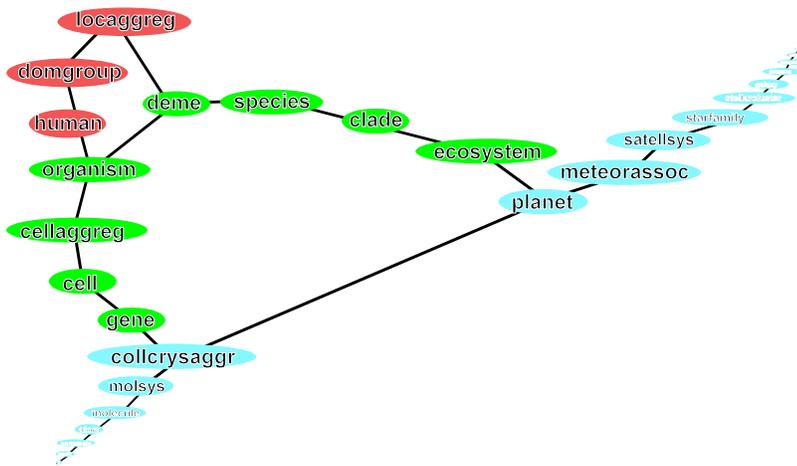


**Figure 4.** Biological Systems Hierarchy

Somewhere in the middle of the hierarchy of physical systems, something quite different “evolved” and there is no doubting that it has a directionality to it — at one point there was no life on earth, but life emerged from the interactions of colloidal components, and then took off. The original system generated new forms and new systems at hierarchically organized levels (Gould, 1981; 2002).

At each level there are different systems, in some cases billions of systems, and each of those systems is a network. And the whole is also a network, a network of networks. Having emerged out of the physical systems, the biological "life systems" form their own hierarchy: cells, organs, organisms, species, clades, etc.

What followed that was just as startling. After some billions of years of biological development the interactions of components already there generated another extremely interesting new systemic pathway. We call it culture, or the sociocultural system. It was new in the sense that there was a time when it did not exist, several million years ago, and then, when the interaction of elements in the biological world reached one of those equilibrium-punctuating events, it appeared. Now, a million years later, socio-cultural systems in a variety of forms, are very prominent on our planet (Figure 5).



**Figure 5.** Origins of Cultural Systems

Human culture is quite different from other cultures you might know or might believe to exist. This new pathway – along which human socio-cultural systems are developing -- may be as different from the biological as the biological was from the material. But it is still made up of networks, and some network generalizations apply to it at every level.

One principle that applies in these cultural circles is “cultural relativism,” affirming that judgments are based on experience, and experience is interpreted by each of us in terms of what we have learned in our enculturation (Herskovits, 1956, p. 49). This is a principle quite analogous to the general principle of relativity applicable to the physical universe. It does not tell you what you should or should not do. It is a statement of how things relate to each other. Mass, gravity, and movement are interrelated in the one case; judgment, experience, and learning, in the other. Relativism does not mean an end to scientific activity, rather it changes the way we conduct science.

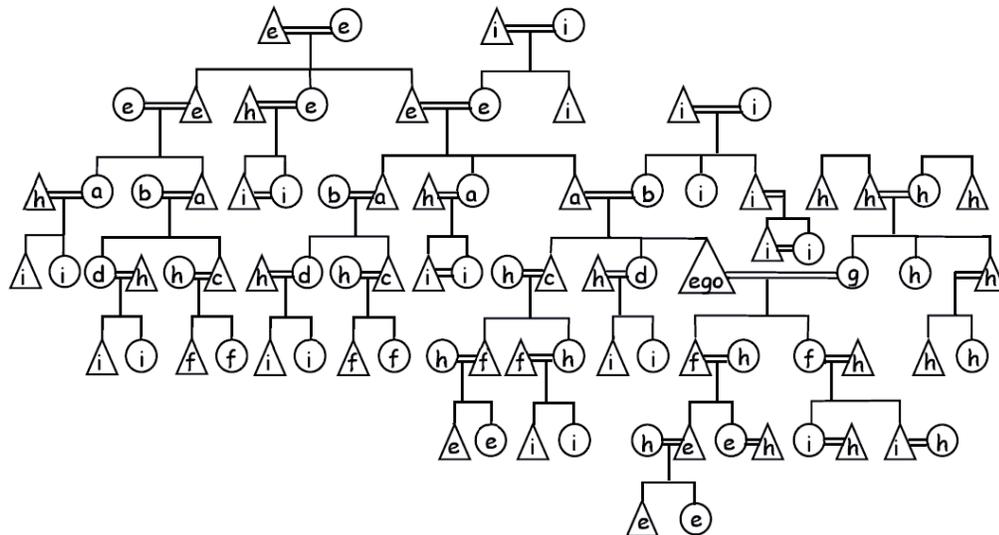
Theories of "cultural evolution" are not popular these days, but empirically there can be no question that there has been a general trend represented in the systems that are associated with culture: greater numbers of people can organize themselves, and there has been a tendency toward more complexity because of the numbers of levels at which people do organize themselves.

For millennia, human beings lived in small local groups or bands of multi-family local groups that followed some learned, cultural, systems of mating, getting food, educating their young, procreation, and so on. At some point, some of these thousands of autonomous bands organized multi-band systems that were more successful in achieving goals. So, thousands of years after they already could

have done so, we find evidence on all continents that that many of these populations developed what anthropologists have tended to called "tribal" organization.

Just as there are hundreds or thousands of ways to organize atoms into molecules and animal organs into organisms, so there are hundreds or thousands of ways to organize human groups into tribes at a level of integration higher than the band. One tribal example is that of the Ngombe of the Congo Basin, in equatorial Africa, whom I studied in the early 1950s (Wolfe, 1961). At that time the Ngombe were organized in a particular kind of "tribal" system that anthropologists have labeled a "segmentary lineage system." In this system every man is surrounded by his patrilineal kin who form a series of fluid yet fully functioning social groups. In such a system each local grouping had as its basis the males of a lineage.

Figure 6 simply reminds us that although there is emphasis on lineage segments at many levels – domestic lineage, economic lineage, exogamic lineage, village lineage , and political lineage -- the full bilateral kinship network is necessary for the functioning of a segmentary lineage system such as that of the Ngombe. Surrounding a male ("ego" at center right) are some eighty-six specific types of kinsmen who, in Ngombe terminology are classified under nine terms (represented by "a" through "i" on this chart).



**Figure 6.** Kinsmen of importance to the Ngombe (copied from Wolfe 1961)

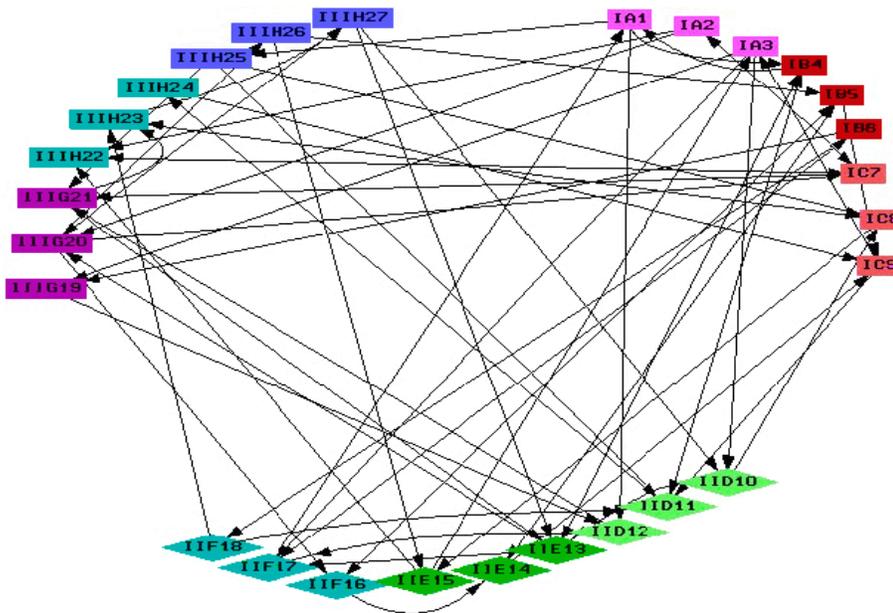
Each line indicates some kind of relation, vertical lines tend to indicate descent, while single horizontal lines indicate sibling relations, and double horizontal lines marriage relations. Those persons of either gender who are descended from a common father, grandfather, great-grandfather, etc. tend to fall into the same class. Each of those who share patrilineal descent will be called by one of three terms, depending on whether the person is: in ego's generation "mwangwambi"(c), above ego's generation "sangwambi" (a), or below ego's generation "mwambi" (f). Each kinsmen whose relation to that crucial male lineage is through a marriage relationship is in a category of affines, "mokiombi"(h), except that those who are related to ego through his own biological mother are a very special category for him, called "nokembi"(i).

Understanding this seemingly complex network of relations is fairly straightforward when one knows something of the wider system. Keeping in mind the crucial importance of the patrilineal descent relation, brothers are virtually identical, always living adjacent to each other and only the slightest removed from their male patrilineal cousins. With those cousins they form what might be called an "economic lineage segment" so called because they share whatever goods they have. What kind of

goods? Goods like knives, spears, other “hard” valuables that are passed among lineage units as part of a system of bridewealth. Every marriage involves long term obligations that the husband’s patrilineal group undertakes to give bridewealth to the patrilineal group of the wife for a period of many years, as long as the marriage lasts. A result of this system of marriage is that every lineage relates to a number of other lineages in two ways – either it is obligated to give goods to that other lineage because one of its males married a woman from that lineage, or it has the right to demand goods from that lineage because one of its “daughters” married a man from that lineage.

The rules are such that there can be only one marriage relationship between any two “economic lineages,” so that ego’s sister or daughter cannot marry into the same economic lineage as ego’s son or cousin gets his wife from. There can be no “exchange marriages” that might reduce transaction costs, so to speak. Furthermore, a rule of exogamy prohibits marriage between persons belonging to the same lineage segment at a wider level than the economic lineage. The consequence of these rules is a very highly connected network of bridewealth obligations over a broad area of Ngombe territory. This is terribly important, because there is among these people no tradition of market exchange. This bridewealth system was the primary method of not only distributing useful capital goods but also of generating a stock of capital goods that was thus available for use when needed. Modern economists would label that stock as “savings.”

Figure 7 is meant to illustrate how the patrilineal segments are woven together into a very complex network not only through their descent ties but through lateral ties of kinship and marriage. Marriage was definitely a contract among lineage segments, generating obligations extending not just through the existence of one couple (represented in a bride-wealth pattern) but beyond the lives of those partners through a pattern of levirate and through a special relationship between each person and the patrilineal group of his or her mother.



**Figure 7.** Flow of Bridewealth Among Segments at Different Levels of Organization.

Each node is an “economic lineage” composed of several households with depths of two or three generations. The arrows show the direction of flow of bridewealth – goods flow from the lineage of the husband toward the patrilineal lineage of the wife. Commonly three economic lineages make up an exogamic lineage, so marriage relations must reach out beyond adjacent lineages. In this illustration,

three exogamic lineages make up a village lineage, so that the illustration is a model of a three-village social situation. Some marriages (not shown) would connect with economic lineages and exogamic lineages in villages not shown in this figure. Between any two economic lineages there can be only one marriage relationship. This, and the rule of exogamy, forces the establishment of a fairly wide well-connected network. Well-connected is a good description, for each line represents major obligations to transfer capital goods important to these Ngombe villages. If there are any market-based transactions, or if ideas of maximization enter into the Ngombe system at all, they are completely embedded within this wider matrix. Translated to an American or European setting, it is as if all the major institutions – corporations, churches, non-profit organizations – in a metropolitan area had mutual assistance agreements with one another.

What is important to appreciate is that such a “tribal” system is a complex network with a hierarchical structure – household level, economic lineage level, exogamic lineage level, village lineage level, political lineage level – even though there is not really centralization of power in the hierarchy. A multitude of ties actually exist in such a system because there are as many ties as there are marriages and offspring of marriages, and no two marriages can connect the same two segments. Such a system enables collaboration and communication and cooperation on a fairly broad scale without centralized control.

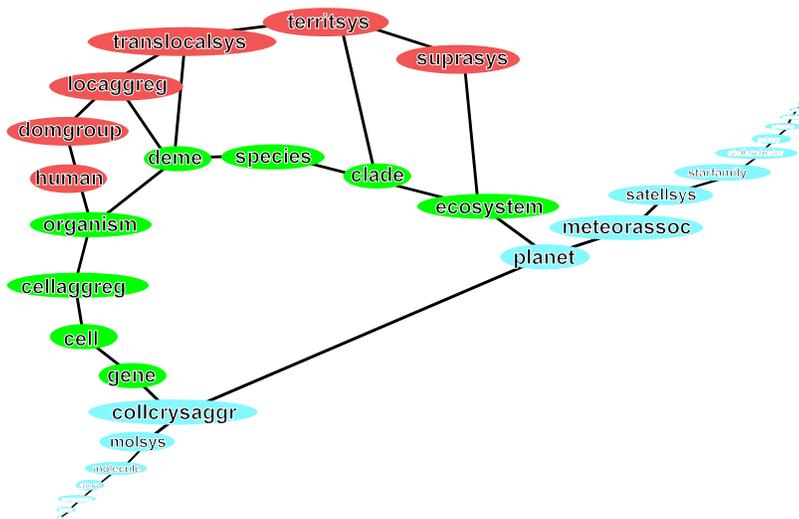
Such tribal systems -- and the Ngombe exemplify only one of many types that coexisted on every continent of the world -- evolved many millennia ago from the pre-existing band-level systems providing human beings with ways of organizing larger populations. The best way of conceptualizing and visualizing such evolution is to see it as a process of interaction among units at these several different levels such that out of the interaction new concepts (e.g., lineage and life-force through descent) and new rules (e.g., importance of mother’s brother” are generated.

Julian Steward generalized the development of these many different ways of organizing people in what came to be called “multilinear evolutionary theory.” (Steward, 1955). When new social formations evolve, older forms do not necessarily die out or remain stagnant as useless survivals. Those earlier forms at lower levels often change and adapt to form parts of new systems at the higher level of integration.

So there are multiple developments along the socio-cultural evolutionary line. With more reliance on domesticated plants and animals we have more stable and dense, clustered, populations, and there is considerable differentiation evidenced. Some of these, when there is evidence of greater centralization, are labeled by those who study them, “chiefdoms” or “kingdoms.” There is a tendency toward specialization of organizations (call them corporations, if you will) and toward organizing by territorial boundaries more than lineage and other principles. Those would be represented on Figure 8 by the bubbles labeled either trans-local or territorial systems, depending on the extent to which territoriality is emphasized.

Only within the last ten thousand years have we seen the generation of very dense urban populations and evidence of control over bounded territory that is associated with nation-states. Figure 8 illustrates that further development in sociocultural evolution, as an extension building upon all those that were developed earlier.

The pattern of development of these kinds of systems can be seen as creating a hierarchy not unlike the materials hierarchy, and not unlike the biological systems hierarchy. Certainly, these hierarchies can be seen as networks. There are the smaller networks nested within the larger ones at all levels. Components of the subsumed networks have some connections with components of the broader networks. Hierarchical clustering expresses the general structure, but of course it is more complicated than any representation can show.



**Figure 8.** Hierarchical Arrangement of Socio-Cultural Subsystems

How many socio-cultural levels are there? People everywhere learn to see some things as being natural, fixed and real while other things are believed to be merely probable or even only possible. European cultures, from which most American ideas derive, have tended to see market transactions (rational exchange, maximization of returns, getting the most you can for what you give) as natural, while altruism, reciprocity, and other modes of transaction are seen as unnatural. These latter must be explained when they occur, whereas the former don't require explanation.

That narrow vision of human interaction has led to the fairly specialized development of economics as the study of the consequences of transactions of the first type, and it has led to our society's over-reliance on economics in all aspects of life. Isn't it strange that it took generations of work by anthropologists and sociologists to get some recognition of the fact that market transactions are embedded in a much more complex network of transactions? Anthropologists, at least, had been talking about that for generations (Malinowski 1922; Bohannan and Dalton 1962).

The political state or nation-state is another construct that Europeans and Americans have come to see as a natural phenomenon. It seems to be treated by scholars and the public alike as the inevitable outcome of thousands of years of evolution. Scholars have somehow got it into their heads that the State is the highest level of integration, something natural and permanent.

Common concepts like state, nation-state, country, firm, company, and corporation are imbued with cultural meanings that have been fixed in our languages and institutional memories. We put states in a categorical box, and we put business firms in a completely separate box, making it difficult to see that their interactions are generating a system at a still higher level of integration. Although many speak of globalization as a process, few have seen that process as a network development process leading to a genuinely new social form. That new formation is at a "supranational" level, above the level of any given nation or set of nations (Wolfe 1977).

While states and business firms have been around for thousands of years, in the perspective of millions of years of evolution these are both relatively recent emergents, having been constructed through the processes of adaptation that generate all social formations. Anthropologists have not given these forms the kind of attention we have lavished on institutions of family and kinship and community. Now, when it is critical that we understand them and their relations, we seem to be accepting the wisdom of conventional political scientists and economists. We have not subjected these

concepts -- business firm, corporation, state -- to analysis in the light of our own comparative and emic/etic perspectives.

In this beginning of the twenty-first century, one cannot talk about the world economy without deliberately taking into account the actions and transactions of multinational firms and enterprises. Many multinational corporations are engaged in transactions of greater dollar value than the entire trade of many of the nation-states studied. The argument has been made that every firm is included in one or another nation-state. While there is a certain legal truth in that view, there are also good reasons to view the situation differently. We are talking here about control over resources and control over persons. Of course, every corporation is registered in one or more state, and many transactions of multinational corporations are included in the statistics for countries or states, but if you really want to know about the world economy, you must also attempt to trace the decisions major corporations make about the disposition of the goods and services under their control. Multinational corporations make a variety of arrangements to assure that transactions do not appear as transactions in order to avoid duties, taxes, imposts, publicity, etc.

At the 1986 Sun Belt Social Network Conference, Linton Freeman, Kim Romney, and Sue Freeman (1986, but see also Freeman 1992) presented an interesting paper on the problem of informant accuracy. That paper has a parallel in our situation at the supranational level. "Somewhere between experience and recall," they said, "our informants were somehow warping the information about the event(s)." Freeman, Romney and Freeman explained that persons develop mental structures that reflect the regularities of their experience. Those structures then intrude on perception and recall in such a way that experience is shaped by expectations as they are stored in memory.

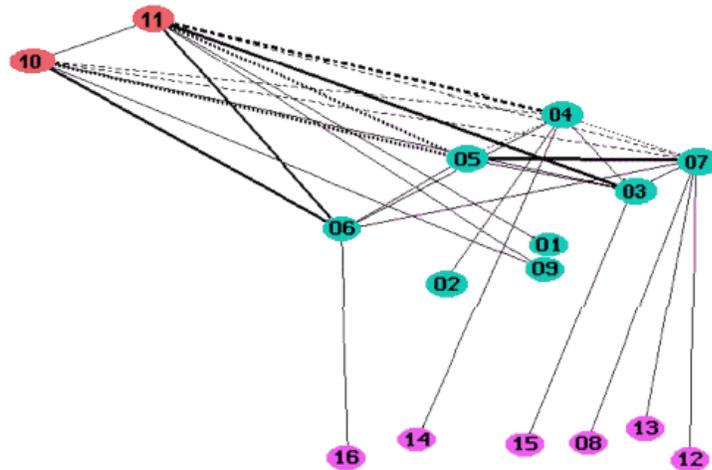
True as this may be for individual informants, such mechanisms operate in an exaggerated fashion as we move up from individuals through institutional levels. And when we reach that cultural construction that goes by the name of nation-state those institutional memory distortions get fixed almost indelibly. Anthropologist Cyril Belshaw's (1976) statement that the concept of national boundary distorts our analyses of social reality was a far too mild complaint. Social science interpretations are falsely biased by nationalistic assumptions and the national bases of data collection. We seem to have built national states so firmly into our culture that even a school of social history that purports to be interested in World Systems ends up merely cataloging and ranking nation-states on a core-periphery scale.

All of our institutions are so biased in that way that it is difficult to find data that are independent of the nationalist assumption. Mary Douglas makes a pithy observation in her 1986 book, *How Institutions Think*: "Institutions have the pathetic megalomania of the computer whose whole vision of the world is its own program" (1986:92). How appropriate an image for this network problem! While that highest supranational level is of great interest, it is difficult to get the data needed to describe it well in network terms. At least it has not been done.

The failure to see that states and firms are major players in a unique supranational "circle" makes it very difficult for us to study the structure of that highest level complex system. It may be possible, however, to study complex systems that are similar even though they are at lower levels.

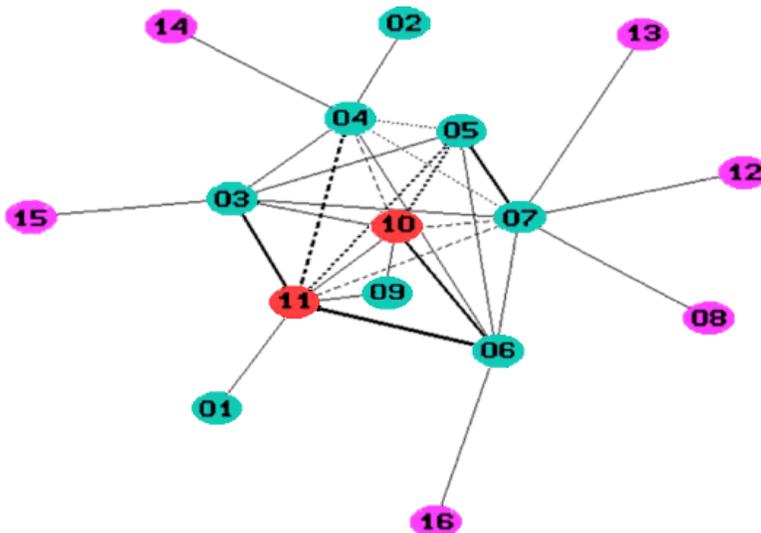
I am working on such a task -- a pilot for the real thing, one might say. The set of public and private organizations involved in matters relating to children and families is a system that probably is structured very much like the entire supranational network.

My study of approximately 600 organizations, public and private, policy making and service providing, in the Tampa Bay Area of the west coast of Florida, is an attempt to do something like that. Using network techniques for measuring centrality, clustering, and equivalencies, I found a three-level structure such as that illustrated in Figures 9 and 10.



**Figure 9.** Structure of Regular Equivalence Relationships among 600 Agencies in the Tampa Bay Area. Each node represents a set of regularly equivalent agencies, and each color represents a cluster of sets based on their regular equivalence scores.

Figure 10 shows those same equivalence clusters distributed according to their closeness in terms of average geodesic distances between the (unseen) nodes within the different clusters. Each visible node actually represents a set of agencies that are regularly equivalent. The network as a whole has a closeness centralization index of 0.58, and a betweenness centralization index of only 0.23. If this is not quite as centralized as the view in Figure 10 makes it appear, this is partly because (1) each node represents a set of agencies that have regular equivalence, and (2) this is a two-dimensional view of what is obviously a multidimensional network.



**Figure 10.** Average Geodesic Distances among the Clusters of 600 Agencies in the Tampa Bay Area.

The distribution of these six hundred nodes in sets of regularly equivalent nodes and the fact that those sets fall into three hierarchically arranged levels needs to be carefully studied and interpreted. It does appear to be quite consistent with the general idea that complex systems tend to be constituted of hierarchically arranged subcomponents.

Herbert Simon has put it well: A complex system, made up of a large number of parts that interact in a nonsimple way, will evolve from simple systems much more rapidly if there are stable intermediate forms, "sub-assemblies," than if there are not, and the resulting complex form in the former case will be hierarchic (1977:209). "In hierarchic systems we can distinguish between the interactions among subsystems, on the one hand, and the interactions within subsystems -- that is, among the parts of those subsystems -- on the other. The interactions at the different levels may be, and often will be, of different orders of magnitude" (Simon 1977:209).

The clusters of regularly equivalent agencies that we find in the subject metropolitan area are analogous to the supranational system of firms and states because they are both constituted of a mixture of public and private organizations. I believe the structure of the supranational system might well be discovered by methods such as we have used in this local project, by graphing both states and firms (government corporations and business corporations) in the same way.

Before closing, I would like to mention another way in which network analysis or at least network imagery can help us interpret a large modern governmental structure. Within the past ten years there have been enormous changes in the government of the State of Florida. In a few years a set of small adjustments moved the state from one in which the governorship was very weak (Jreisat and Wolfe 1995) to one in which the governor is extremely powerful (Jreisat and Wolfe 2002). Network-like images of a major portion of the governmental structure of Florida are shown in Figure 11, for the year 1995, and in Figure 12, for the year 2002. Shown here are three major functions of state government – higher education (Educational Commissioner, Board of Regents, University Presidents), child and family welfare (Secretary, Department of Children and Families, District Administrators, Health and Human Services Boards, Nominee Qualifications Review Committees), and the state judiciary (Florida Bar, Judicial Nominating Commission, Judges).

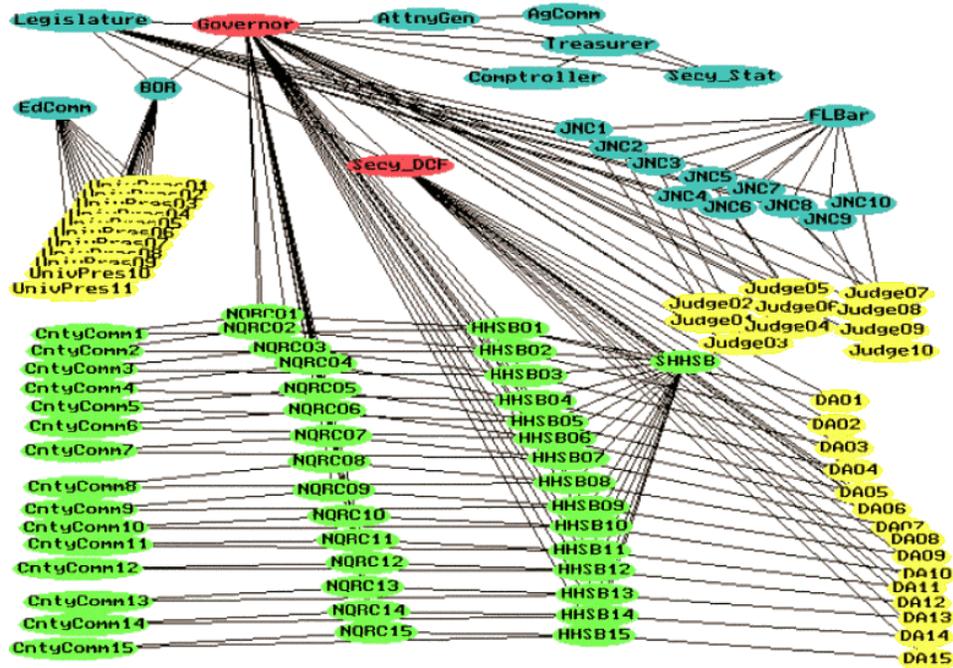


Figure 11. Graphic Illustration of Florida Governance Structure in 1995.

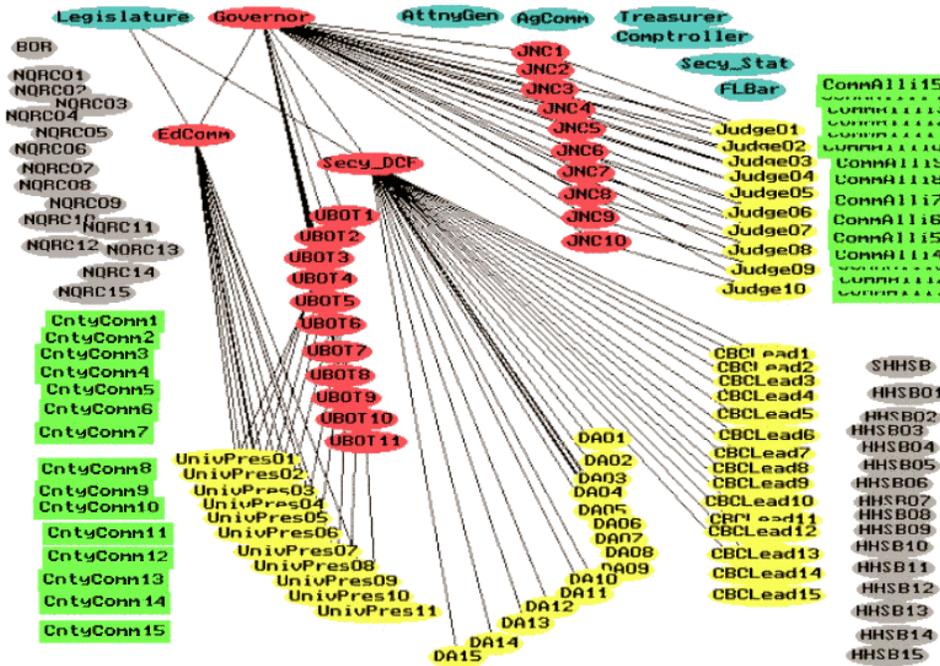


Figure 12. Graphic Illustration of Florida Governance in 2002.

The color coding is important here: The governor and agencies directly controlled by the governor are red. Nodes that are cyan are statewide offices that have some independent status such as being elected statewide. Green indicates nodes that represent local input into policy, e.g. county commissions. Nodes that are essentially administrative, carrying out policies established elsewhere, are yellow. In Figure 12, the nodes colored gray are ones that were deleted by legislation in 2000, each of those nodes having had significant local input in 1995, in which figure they are green. In Figure 12 they are gray shadows and completely disconnected. Some nodes, such as county commissions, remain green in 2002 because they represent local communities, but they are disconnected, virtually powerless in the governance structure of these state functions in 2002. They no longer have ties to the state implementing agents whose appointments they once could influence. The network that remains is obviously a highly centralized one, with the governor having much more direct control than the office had in 1995.

**Conclusion**

I have not been concerned to define either dots or circles carefully. Circles -- the cohesive and structural clusters, the domains, and the fields -- at one level of analysis become mere dots at higher levels in one of the three major hierarchies of systems and subsystems -- in the hierarchy of physical and material systems, in the hierarchy of evolving biological systems, and in the hierarchy of our rapidly developing sociocultural systems. Dots -- the nodes in networks at any level -- become complex networks themselves when viewed in the right perspective.

We present-day human beings should keep our minds open to all the possibilities that can be generated through the interactions among the dots and circles of these systems and subsystems at so many different levels. An occasional glance backward along the paths we have travelled in the evolution of these complex systems will help prepare us to see the possibilities ahead.

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