

The Rise of Network Thinking in Anthropology*

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The encyclopedic inventory of the first half of the twentieth century, "Anthropology Today", published in 1953, gave little inkling that within a few decades developing trends in social theory, in field experience, in electronic data processing, and in mathematics would combine to bring to prominence a distinctive theoretical approach using a quite formal network model for social systems. Now, sophisticated mathematics and computer programming permit sophisticated network models -- networks seen as sets of links, networks seen as generated structures, and networks seen as flow processes. Although network thinking has shown a dramatic rise from the "Anthropology Today" of 1953 to the current anthropology of 1978, it is predicted to soar in the next quarter century, much of the weighty burden of network analysis having been lifted from us by ever more rapid electronic data processing.

Introduction

In March 1977 I was asked whether I would be interested in participating in an electronic information exchange system being organized on a trial basis for the community of scholars interested in social networks. Douglas White, an anthropologist, was among the organizers of the "network network" as the system came to be dubbed. Sponsored under a National Science Foundation program, the project links together members of a scientific research community in a year-long electronic conference. As Linton Freeman, the director of the project, puts it: "... those of us who are working on social networks form a natural community for such an information exchange system. We are geographically dispersed. We represent several disciplines. We are working on a diffuse set of problems that are just now coming to be recognized as interrelated. Our area is one of the very few in all of social science that is currently vital and growing. And, since this sort of computer based network is itself a natural object for study within the scope of our interests, we are an ideal community to produce the sort of self-evaluation the National Science Foundation wants out of this program" (Linton Freeman, personal communication).

This NSF project relates to the topic of this paper, "The rise of network thinking in anthropology", in several ways. As will become evident in the course of this paper, developments in mathematics and in electronic data processing are vital to the present and future rise of network thinking in anthropology and other social sciences.

Without intending to review in detail the intellectual history of the field, I note that neither "Anthropology Today" (Kroeber et al. 1953) nor "An Appraisal of Anthropology Today" (Tax et al. 1953) makes significant mention of the concept of social network. That encyclopedic inventory of anthropology of the first half of the twentieth century, represented in those publications, gave little inkling that within a few decades developing trends in social theory, in field experience, in mathematics, and in electronic data processing would combine to bring to prominence a distinctive theoretical approach using a quite formal network model for understanding social systems. The term "network" does not appear in the index of "Anthropology Today" nor in that of "An Appraisal". Of all the contributors to those volumes,

only Eliot Chapple seemed faced in the new direction. In the discussion, Chapple (1953:304) wrote, "We can, in fact, use a modified form of the kind of network analysis used in electrical work... and we can determine the effects of any change in the quantitative values assigned to any link on its neighbors in the network pattern". Still, as we shall see, although Chapple has made important contributions in the succeeding decades on methods of analyzing human interactions (Chapple 1970, 1971; Chapple and Yan-Yin Lui 1976), the literature on social networks that grew in abundance in the 1960s and 1970s fails to reflect those contributions very fully. In anthropology, especially, the beginning of serious theoretical thinking about networks must be credited to J. A. Barnes (1954), followed almost immediately by Elizabeth Bott (1957, 1959). It was not, however, until the very late 1960s that the idea really came into prominence. In 1976, Freeman (1976) published a "Bibliography on Social Networks" containing over 1500 entries, only a small proportion of which date prior to 1965.

Although anthropologists may have accepted in a very general way the notion that a social system could be seen as a network of social relations, nobody until the 1960s seemed excited about the theoretical possibilities of such an analogy. Since 1969 there has been an acceleration in the development and use of network concepts by anthropologists. Numerous articles on the subject have appeared in anthropological journals. Several collections of articles have been published: "Social Networks in Urban Situations" (Mitchell 1969), a special issue of the "Canadian Review of Sociology and Anthropology" (Aronson 1970), and "Network Analysis: Studies in Human Interaction" (Boissevain and Mitchell 1973). Symposia focusing on the network concept have been organized at each annual meeting of the American Anthropological Association. In addition, extensive reviews of the subject have recently appeared, in a Module series (Barnes 1972), in the "Handbook of Social and Cultural Anthropology" (Whitten and Wolfe 1973), and in the "Annual Review of Anthropology" (Mitchell 1974). A network model is being applied to a wide array of problems: elections, management, health services, getting jobs, education, community organization, language policies, mental hospital admissions, therapy, conflict in small groups, organization of research teams, multinational enterprises, and the list expands.

Why this rise in interest in networks? the introductory statements of most of these works to which I have just referred tend to justify the network orientation by reference to the need for new models to aid in understanding urban and complex social phenomena. In fact, the works themselves are frequently devoted to the anthropological study of urban phenomena: Mitchell's book is entitled "Social Networks in Urban Situations", and the "Canadian Review" issue developed out of a symposium at a plenary session of the 48th Annual Meeting of the Central States Anthropological Society, in 1969, entitled "Urban social networks". And when one looks at the close association in Africa between the study of urbanization and the turning toward network concepts, one is almost ready to argue that the network image of society comes to mind when we study city life. In the decade just passed, many of those anthropologists who have studied African cities have come out of the experience thinking in network terms (Aronson 1970; Epstein 1961; Gutkind 1965; Hannerz 1966, 1967; Jacobson 1970; Mayer 1961, 1964; Mitchell 1959, 1966; Parkin 1969; Plotnicov 1967; Southall 1961).

There is, as just implied, a good bit of evidence to suggest that the study of urbanization is the stimulus of the development of network analysis. It may well be true that until anthropologists in Africa went into cities they did not find networks, or at least not to such an extent that they needed to elaborate concepts for their description. In tribal studies,

traditional group structural, institutional, concepts were made to do the job of description even though some scholars, such as Fortes (1949) and Gluckman (1940), felt uncomfortable about the failure of those concepts to deal adequately with situations involving change and choice. So, when Africanist anthropologists saw how important were personal networks to understanding Africans' behavior in cities and between town and country, they simply had to develop theoretical concepts that would bring such personal networks into their accounts.

But it would be naive to take what we have just said about the relation between urbanism and network studies in Africa without asking why so many other social scientists have studied urbanism in other world areas in depth without similarly feeling impelled to describe what they studied in network terms. I am thinking especially about the tremendous development of urban studies throughout the twentieth century centering in and focusing on Chicago. One would think that, if network concepts proved useful to those anthropologists studying African cities in the 1960s, they would also have been useful to those anthropologists and sociologists studying American cities in earlier decades: Why did they not feel the need to develop them?

I see at least four areas in which to place the bases for the rise of network thinking now - and thus, in part, to account for its lack of development earlier and, perhaps, to venture some prediction as to where the approach might lead by the year 2000, only twenty-two years hence.

These bases lie in social theory, in ethnographic experience, in mathematics, and in the technology of electronic data processing. I list these not in order of their importance to the question, but simply in the order in which I will elaborate them. I will attempt an assessment, not so much in terms of implications for understanding the past as in terms of where network thinking might take us in the future.

Social theory

In many respects, the network model of social systems is a logical outcome of four theoretical trends that seem to have been mutually reinforcing for a number of decades. Certainly they were evident already in "Anthropology Today" and "An Appraisal". (1) There is the trend toward interest in relations rather than things. (2) There is the trend toward interest in process rather than form. (3) There is the trend toward seeking out elementary phenomena rather than institutions. (4) There is the trend toward constructing generative models rather than functional ones. Being aligned with one or more of these trends does not necessarily constitute a network approach, but all of them together would seem to lead inevitably toward a network model.

To the network analyst, relations among persons are at once elementary phenomena and they are processes that generate social forms that are themselves subject to continual regeneration and adaptation to changing circumstances expressed in relations among persons. The network analyst does not conceive a social network that is structurally fixed, does not reify the patterns of relations observed, does not attribute purpose to them. Purpose enters only at the level of the elementary relation, which has persons transacting. Yet, the network approach does not entail reductionism, for the relation itself is more than the sum of its parts. Network theory, when it develops, will generalize about relations among relations, how transactions affect such relations, how such relations affect

transactions. But though they depend on transactions, these network statements will not be a kind of economics, for the relations at issue are not those between resources (e.g. "prices") but rather those between actors (true social relations).

Perhaps I should not at this point anticipate too much the nature of the ultimate theoretical product of network thinking. It is enough for now to recognize that network thinking is one of the several possible alternatives to theoretical approaches of the past that have proven quite unsatisfactory. The rise of network thinking as a reaction to failings of the past has been dealt with by Aronson (1970), Whitten and Wolfe (1973), and Mitchell (1974). What I want to do here is to call your attention to those areas that have received less attention: ethnographic experience, mathematics, and the technology of data processing.

Ethnographic Experience

The anthropologists working with network models often have had, prior to their urban experience, direct field experience with peoples for whom kinship relations were extremely important. In contrast, other social scientists who had earlier devoted attention to the American urban scene did not, for the most part, have prior ethnographic experience.

I refer here to people like Robert Park, Ernest Burgess, T. V. Smith, L. D. White, Louis Wirth, Everett Hughes, among the many participants in the Chicago School of Social Science Research (Wirth 1940). Furthermore, whether or not they have had experience in a kin-based society, anthropologists traditionally put great emphasis on first-hand, direct, participant observation, virtually the hallmark of anthropology.

In any event, I do believe ethnographic experience is an excellent grounding for a network orientation, whereas the institutional and survey methods traditional in other disciplines do not lead naturally and directly to a network orientation. In fact, survey methods almost force one to leap from one subject (person) to another, each randomly chosen, or, worse still, deliberately chosen because the one has no relation to the other and is not thus "contaminated".

Ethnographic experience, in contrast, makes deliberate use of all connections possible, as a matter of course, to get entree and develop rapport. Whether she or he intends to or not, the anthropologist must learn a great deal about the network of relations of her or his informants. And this, I argue, readies her or him for serious concern about the forms and functions of social networks.

I know that my own experience attempting an ethnography of the poor in the Soulard Area of St. Louis, Missouri, led me and some other members of our research team directly to an interest in network studies. In a paper entitled "The effects of first contacts by researchers in urban fieldwork", Barbara Lex and I put the problem thus:

"In addition to those rather standardized societal institutions which are generally shared, the total social field is composed as well of a highly differentiated network of personal interaction. 'Highly differentiated network' is not really an adequate phrase to imply the enormous complexity of an urban social field. That complexity is better pictured if one conceives of innumerable egocentric sets of interpersonal relations, most of which lack well-defined boundaries... (carrying) a varying hodgepodge of content. Obviously, such an urban interpersonal network cannot be described in its totality. The ethnographer's primary

problem is how to describe it at all: how to observe it, and how to get a 'representative sample' of it. To observe, he must participate to some extent, but participation in some sets precludes participation in others. So varied is the total network that one ethnographer's sampling must always be in doubt." (Lex and Wolfe 1967:2)

A.. L. Epstein's use of the network model in 1961 is sometimes cited as breaking new ground in anthropological fieldwork when he had his African informant, Chanda, in Ndola on the Copperbelt, record in some detail his "movements around the town and the contacts...made with various people in the course of a number of days". Epstein saw that particular study, wherein part of the network of a single person was traced, as looking toward "the development of a methodology of systematic approach to the anthropological study of urban communities" (1961 :32). Nonetheless, from one point of view this innovation is only a slight extension of traditional ethnographic procedure. Epstein's ethnographic experience lay directly behind what he called methodological experimentation.

Another, and my final, example of how ethnographic experience prepares an anthropologist for conceptualizing networks is the work of Norman E. Whitten, Jr. In describing and comparing his studies in Ecuador and Nova Scotia he has this to say: "I would argue that, marginal though he may be...a competent ethnographer becomes central to a data-gathering, rumor-distributing network that usurps power from other systems. Because the anthropologist must learn as much as possible in a short time, he is bound to make close friends and through them to work outward in ever-ramifying networks of interpersonal relationships."

Whitten continues,

"I suggest that people whom the ethnographer comes to know best in a given system perceive, in one way or another, some strategic advantage to continued association with an outsider. I further suggest that their perceptions and their tactics to involve the anthropologist more firmly in their network of relationships can generate data valuable to the analysis of cultural mechanisms of network formation and maintenance. Seen from this perspective, then, part of the anthropologist's problem is to understand the methods and mechanisms by which people are placing him in a lattice of ramifying ties"(Whitten 1970 :398).

Whitten's work demonstrates well the point that ethnographic experience can lead one, almost naturally, toward the network image of social relations.

Mathematics

The metaphor of social relations as "a complex network" is much easier to accept than is the formal analytical model of social network that anthropologists are now beginning to use. Thus, when Radcliffe-Brown (1940:3) described Australian social structure as being based on a "network" of dyadic relations of person to person, his readers understood intuitively what he meant. And when W. Lloyd Warner and Paul Lunt (1941:111) said of Yankee City, "...overlapping in clique membership spreads out into a network of interrelations which integrate almost the entire population of a community in a single vast system of clique relations", they communicated a sense of the complexity of social life. However, the network analogy is actually more useful when it becomes a formal theoretical model, when

some characteristics of the links that make it up are defined and when some characteristics of delimited portions of the whole are defined so that we can compare one

"network " with another and make statements about their similarities and differences.

Modern network analysts are using terms, such as connectedness, flow, cut points, centrality, range, span, density, transitivity, which are foreign to traditional anthropology. They come to us, and are still coming to us, from several branches of mathematics, which are, if not brand new, at least relatively modern and still developing. Graph theory, topology, and matrix algebra are providing the concepts and theorems that lead to the mathematical study of abstract systems called networks. Without this kind of advance in mathematics we could not hope to get far in the development of social network models. Major references to these mathematical contributions are recent ones (Coleman 1964, 1975; Flament 1963; Ford and Fulkerson 1962; Harary et al. 1965; Kemeny and Snell 1972; Kemeny et al. 1966 ; Kleinrock 1975; Rapoport 1957; White 1973). So, although many social scientists who were trying to develop theory to cover urban/complex societies in the first half of the twentieth century were relatively sophisticated mathematically -at least, sociologists and social psychologists have traditionally been more sophisticated mathematically than have social anthropologists -they simply did not have the developed base in mathematics on which to build the network models to apply to social phenomena.

Up to a point it is largely a question of mathematicians developing theory and social scientists following in the wake hoping to be led toward new insight. Later, however, and that time seems to be arriving in the case of networks, social scientists pose the problems which mathematicians will address. People like Mark Granovetter (1973, 1974a,b), H. Russell Bernard and Peter Killworth (Bernard and Killworth 1973; Killworth and Bernard 1974, 1976) are, it seems to me, raising such questions now in regard to what I think of as the structural aspects of social networks, questions that concern the distances that separate persons in a network and the patterns observed when, say, there are local clusters bridged to one another by certain kinds of links. Others, like John Burgess (1974), Edgar Dunn (1970), Harrison White (1973) and Wayne Zachary (1975) pose questions not so much in terms of patterning of persons and links as in terms of the flow of something through the system.

I am not going to try to explain the mathematics involved in any of these approaches, but with reference to our subject, network thinking in the future of anthropology, there is every reason to be optimistic. Progress is being made across a broad front relevant to the problems, and anthropologists, such as Barnes (1969), Niemeijer (1973), Douglas White (1973), as well as Bernard and Zachary just mentioned, are among the contributors.

The technology of electronic data processing

In considering the current and future rise of network thinking, one could not possibly exaggerate the role of the technology of electronic data processing. Without such means of storing and retrieving myriads of bits of data one could not dream of actually working with a network model that bears close relation to the empirical reality of ramifying personal links of all kinds.

In empirically based descriptions of the past, one knew all those links were there, but dared to deal with the components of which the network is constructed only in small group sociometric studies (Moreno 1951), in narrowly specialized areas such as the diffusion of medical practices among doctors (Coleman et al. 1957), or by a method of aggregation whereby some consequences of network functioning could be learned by survey methods

even without knowing details about individual links (Coleman 1958).

The problems of collecting, storing, retrieving, and analyzing data are critical for network analysis because the number of linkages, or relationships -even symmetrical ones - increases almost exponentially with the number of people being studied. With four people there are potentially six symmetrical links (if each has a direct relationship with all the others); with ten people there are potentially 45 symmetrical links; with one hundred people there are potentially 4950 such links; and with one thousand people there are, potentially, 499500 links.

If one is to do anything beyond mere summation of the data on these links, one needs the kind of lightning-fast computational techniques that have become available to us only in the last two decades. Thus, the possibility is open to us, because of technology, to deal with network concepts such as were mentioned above -density, communication pathways, range, span, anchorage, point bases, reachability, flow, capacity, cohesion, connectedness, clustering, cut points, and so forth. Without the development of computer technology there could not be serious application of network theory to social phenomena.

If we are interested in assessing where this new technology might permit us to go, it is both exhilarating and sobering to see an entire issue of "Science", the journal of the American Association for the Advancement of Science, devoted to what the editors call a continuing "electronics revolution ". Abelson and Hammond (1977) recognize that it has already had enormous influence, but they still say, "Beyond that, an extrapolation of current trends points to an even greater impact" (p. 1085).

For perspective on that extrapolation, consider this: At the time of the 1952 International Symposium on Anthropology which provides the base line for our current assessment, "the first two electronic, digital, stored program computers were ordered by the government to handle the 1950 census" (Davis 1977:1099). Later, in the mid 1950s, there were about a thousand computers in the United States; at the end of 1976, we had some 220000 computers. But, of course, it is not only their numbers, the hard- ware, that count; more important, perhaps, is what they can do, a function of software, programming. Abelson and Hammond (1977) put it clearly: "The electronics revolution is making (an increasing reservoir of scientific and technical) knowledge more readily available, extending intellectual powers often by many orders of magnitude while facilitating greatly the accumulation of more knowledge" (p. 1085). Davis (1977) goes further when he says:

"My belief...is that the balance of power and the ratio of intelligence between man and computer is still indeterminate. Further, it is not entirely under man's control" (p. 1101). Again, Irwin and Johnson (1977:1174) see, right now, exponential growth in sophisticated data communications being created by "new services served by intelligent terminals and linked together with distributed computer networks".

They predict this business, in dollar terms, to leap from \$5.5 million in 1975 to \$22.0 million in 1980. And we, here, are trying to predict the future of network thinking in anthropology to the year 2000! Whatever we say about its continuing rise will probably be an understatement!

Most impressive, and suggestive of what might be accomplished in the near future, is the work of Harrison White. In an article entitled "Everyday life in stochastic networks", White

(1973:43) writes:

"The world is a network of congestion points. One's plane may have had to circle waiting for a clear runway, because an earlier plane had to wait for a fuel truck. ... In the hotel to which one goes, are not only bars and restaurants, but a registration desk, phone booths, elevators, and so on. It has proved hard enough to analyze single congestion points: there is now a huge literature of models dealing with an infinite variety of arrival patterns, service facilities, waiting disciplines, and feedback possibilities such as disgruntled customers leaving the system. Only recently has there been substantial progress in analyzing networks of queuing points, and then only by the clever use of computers for simulation experiments to supplement mathematical analyses."

I venture the guess that although network thinking has already shown a dramatic rise since the "Anthropology Today" of 1953, it will really soar in the next quarter-century, much of the weighty burden of network analysis having been lifted from us by ever more rapid electronic data processing.

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