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ON THE RELATIONSHIP BETWEEN SIZE OF POPULATION AND COMPLEXITY OF SOCIAL ORGANIZATION*

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SOCIAL SCIENTISTS have long been aware that a relationship exists between the size of a society in terms of population and its degree of socio-cultural complexity. Nearly a century ago Herbert Spencer (1885:449-450) noted that "as population augments, divisions and subdivisions [in society] become more numerous and more decided." And Georg Simmel (1902:2) observed that "the sociological structure of a group is essentially modified by the number of the individuals that are united in it. . . .beyond a certain stage in its increase of numbers [a group] must develop for its maintenance certain forms and organization which it did not previously need . . . ."[1]

Nevertheless, until quite recently, no cultural anthropologist had attempted to determine this relationship precisely. Failure to do so can be attributed, in a general way, to a neglect of evolutionary problems, and, more specifically, to the absence of a quantitative yardstick by which socio-cultural complexity could be measured.

However, in 1956, in his pioneer article, "A Preliminary Index of Social Development," Raoul Naroll proposed and applied such a yardstick. By means of it he was able to demonstrate a correlation between size of the largest community in a society and such measures of social complexity as number of craft specialties and number of "team types" (Naroll 1956:689, 701). The present paper is an attempt to explore these relationships further.

In measuring societal complexity we have employed an index different from Naroll's. The index used here is based on a list of 354 traits selected from the major aspects of culture—subsistence, architecture, economics, political organization, religion, etc.—which was compiled for use in a study of cultural evolution by means of scale analysis (Carneiro 1962; Carneiro and Tobias 1963). Individually, the traits represented qualitatively different cultural features. As a group, they were the kinds of traits expected to show cumulation, that is, retention of earlier, simpler ones along with the adoption of later, more advanced ones. Although the list was not originally devised to measure the level of culture

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1 For quotations from other social scientists expressing the same view, see Terrien and Mills (1955:11). See also Dumond (1965:313-315).

of a society, it soon became evident that it could be so used: the more traits a society had, the higher its culture level.

Admittedly, this index takes account only of the presence or absence of certain qualitative features in a society, and not of the frequency of these features. And in attempting to gauge a society's complexity precisely, it is not enough to know that it has clans, towns, temples, markets, provinces, etc.; we want to know *how many* of each of these traits it has. However, the detailed quantitative information required to answer the question, "how many?" is rarely to be found in the standard ethnographic or historical literature. Consequently, we may well have to settle for an enumeration of certain significant qualitative features as the only kind of index that can realistically be applied to a large sample of societies.

The societies employed in the scale analysis study were maximal socio-political units. That is, they represented groups which, while in themselves continuously integrated, were not at the same time permanent sub-units of some larger socio-political unit. This meant that in some cases, like the Washo or Mandan, our societies consisted of single bands or villages, while in others, like Dahomey or Rome, they were kingdoms or empires.

During the course of this study it became increasingly clear that population size and societal complexity were closely related. Finally it was decided to use the data compiled in the study to determine just how close this relationship was. Since it seemed likely that population would be more closely related to the organizational aspects of a society than to all aspects of its culture taken together, it was decided to remove from the list traits which were primarily technological or ideological and to retain only those that were primarily organizational. A trait was designated as organizational if it involved the coordinated activity of two or more persons.[2] The number of traits on the original list of 354 deemed to be organizational was 205.[3] By means of this reduced list the 100 societies in the sample could be ranked according to organizational complexity.

2 Space does not permit listing all these traits here, but, in abbreviated form, some of them are: craft specialization, service specialization, medium of exchange, merchants, markets, wage labor, corvée, taxation, social segmentation, social stratification, sumptuary laws, slavery, towns, cities, formal political leadership, advisory council, state treasury, state ministers, judicial process, code of laws, hierarchy of priests, temples, census taken, and military conscription.

3 Actually, there were at first only 203 organizational traits on the list. However, since two societies (the Tasmanians and the Amahuaca) had none of these traits, and since 0 cannot be entered on logarithmic graph paper, it was decided to add two traits to the list common to the Tasmanians, the Amahuaca, and the other 44 societies in the sample. These traits were "nuclear family present," and "several nuclear families usually aggregated into a larger social unit."

Next came the task of ascertaining the population of the societies, and here considerable difficulty was encountered. A number of societies, both large and small, had to be dropped from the list because population figures for them were too uncertain or lacking altogether. Larger societies, such as tribes, chiefdoms, and kingdoms, were especially problematical, often being too large to have been easily or reliably enumerated. Because of these uncertainties it was decided to exclude all multi-community societies from our study, and to retain only single-community societies. These single-community societies consisted of integrated and autonomous bands, villages, and towns.

After these exclusions were made there remained in the sample 46 single-community societies. On the accompanying graph the number of organizational traits of these societies has been plotted against their population (see Fig. 1). The result shows a close relationship between the two variables.

Before attempting to interpret the graph socio-culturally, let us do so mathematically. Logarithmic coordinate paper was used for plotting because on this type of paper a fixed relationship between two variables, whether linear or exponential, will appear as a straight line. Moreover, the equation for this line is always of the form $y = ax^b$, where the dependent variable, y, is a function of the independent variable, x, raised to some power, b, and multiplied by a constant, a. The familiar formula for the area of a circle, $A = \pi r^2$, is of this type.

A further advantage of logarithmic paper is that it permits one to find the numerical value of various terms of an equation by inspecting the regression line. Thus, to obtain the value of the exponent, b, one simply measures the slope of the regression line, while to determine the constant, a, one has only to note where this line intercepts the y-axis. In Figure 1 we find by measurement that the regression line rises 0.594 units for every unit it extends horizontally, so that the slope, and therefore the exponent, is 0.594. The line intercepts the y-axis at 0.6, making this the value of the constant.

Using the symbols N for the number of organizational traits, and P for the population, in place of y and x respectively, we have the equation $N = 0.6\ P^{0.594}$. That is to say, the number of organizational traits in a single-community society is best given by the size of the population of that society raised to the 0.594 power and multiplied by the constant 0.6.

A reasonably close approximation to this relationship is given by the simpler equation, $N = P^{0.5}$. Now since raising a number to the 0.5 power is the same as taking its square root, we can write, instead, $N = \sqrt{P}$. That is to say, the

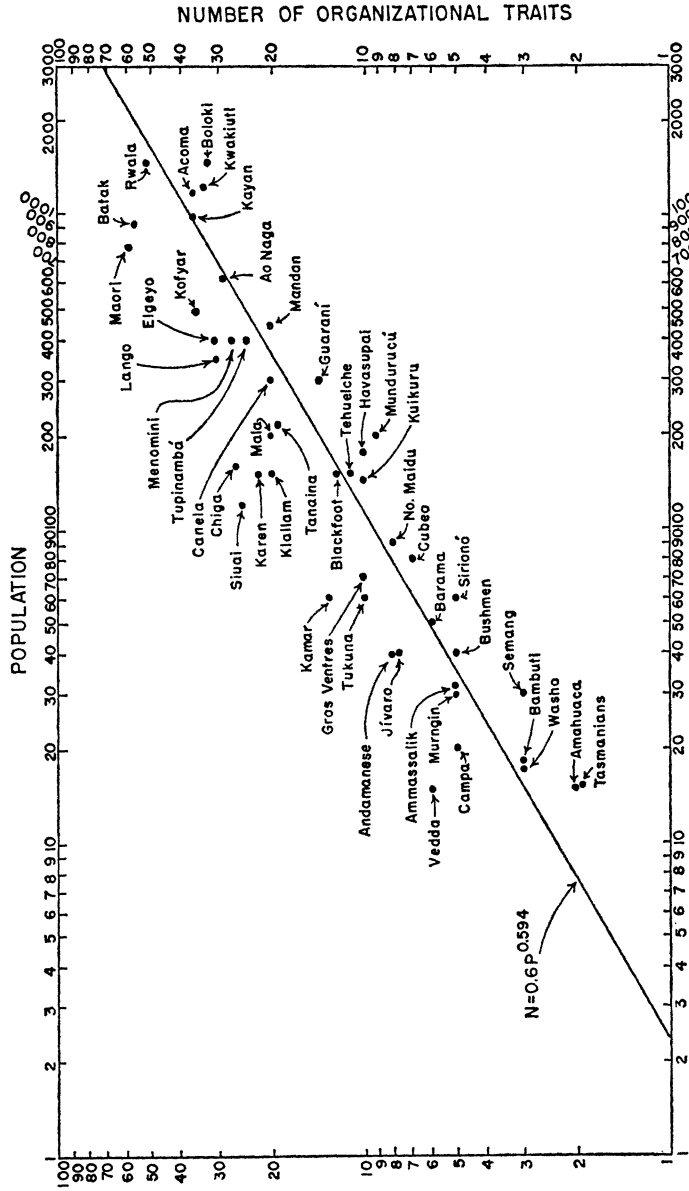

FIG. 1. Number of organizational traits plotted against population size for 46 single-community societies. Regression line fitted by eye.

number of organizational traits in a single-community society is equal (roughly) to the square root of its population.

Before proceeding further, it should be made clear that the numerical values of the terms of the equation we have derived are not to be regarded as absolute and fundamental. These values depend upon the numbers—and therefore ultimately on the kinds—of traits used to measure organizational complexity. If instead of 205 traits we were to use 300 or 500, the equation would not remain the same. While the slope of the line might not change, the intercept undoubtedly would, occurring higher on the *y*-axis. Thus the constant, *a,* would no longer have a value of 0.6, but something larger.[4]

Now if the intercept changed markedly but the slope remained at something like 0.5, we would at least be able to say that while the number of a society's organizational traits was no longer approximately *equal* to the square root of its population, it was still *proportional* to it. But it is entirely possible that with substantially more (or fewer) traits in the index, the slope itself might change. Then the number of organizational traits in single-community societies would be equal (or proportional) to some other root (or power) of the population.

Before deciding to set aside multi-community societies, enough work was done with them to indicate that the relationship between population size and societal complexity was different from what it was in single-community societies. As they grow more populous, multi-community societies appear to elaborate their social structure more slowly than do single-community societies. The reason for this seems to be that societies grow larger primarily by aggregation, that is, by incorporating into themselves smaller, previously independent societies. This incorporation always adds population to the incorporating society, but not always new structural features. This is so because the organizational features of the incorporated societies may simply duplicate those already present in the incorporating one. And, as we have noted, our index does not take account of the addition of more of the same types of structural features.

Of course, the incorporation of an increasing number of smaller societies into a larger one eventually gives rise to new organizational mechanisms to integrate the ever-increasing aggregate. But in proportion to population these organizational features seem to arise less rapidly than they do among single-community societies.

4 Unless, of course, the augmented list were such as to add traits only to intermediate and complex societies, and not to simple societies. But in this case the *slope* of the line would necessarily change, rising more steeply from the same intercept.

Having found a definite mathematical relationship between population size and societal complexity, let us now try to account for it. That there should be *some* correlation between population and social structure is entirely understandable. After all, what is social organization if not the coordination of the behavior of individuals in society? And if so, it follows that the more individuals in a society, the more coordination will be required to keep them operating as a society. There is, of course, nothing new in the recognition of this relationship. Herbert Spencer (1886:281) perceived it many years ago and expressed it in precise terms:

> It is a principle in physics that, since the force with which a body resists strains increases as the squares of its dimensions, while the strains which its own weight subject it to increase as the cubes of its dimensions, its power of maintaining its integrity becomes relatively less as its mass becomes greater. Something analogous may be said of societies. Small aggregates only can hold together while cohesion is feeble; and successively larger aggregates become possible only as the greater strains implied are met by that greater cohesion which results from . . . a . . . development of social organization.

At this point two qualifications need to be made. The first is that more complex social structure does not arise *solely* as a response to increased population. The demands placed on a socio-cultural system by external conditions, especially by the requirements of subsistence and defense, also may call forth new structural features without the necessity for any accompanying increase in population.

The second qualification is that elaborating its structure is not the *only* way in which a society may respond to a substantial increase in human numbers. Should the society increase in size beyond some critical point without developing any new organizational features, it might simply split. With internal stresses thus relieved, the two resulting societies might well be able to continue functioning adequately with the existing structure.

Thus the thesis advanced here is not that societies become more complex *only* by growing larger, or that as they grow larger they *invariably* become more complex. Rather, the contention is that if a society does increase significantly in size, and if at the same time it remains unified and integrated, it must elaborate its organization.

That the number of different kinds of structural features in a society should increase as some *root* of its population rather than at the same or at a greater rate is not surprising. No one would expect that for every additional person

in its midst a society would require a new practice or custom, let alone a new institution. As a rule, an increment of at least several persons is needed to bring about one structural change. Unit for unit, then, we can say that a society's structural complexity increases more slowly than its population.

To understand how an increase in numbers brings about an increase in organization we need to view the process from a broader perspective. We need to see it in terms of an interaction between *growth* and *development*. Growth is an increase in substance, while development is an increase in structure, and the interplay of the two, giving rise to successively more differentiated forms, constitutes evolution.[5]

Let us look more closely at the relation of substance to structure. While the two are logically distinguishable, they are, in fact, inseparable: substance always occurs as structural units of some sort. Thus growth, which appears externally as an increase in size, manifests itself internally as an increase in units.

Yet growth by the simple multiplication of elementary units, such as by the proliferation of cells, cannot proceed indefinitely. Beyond a certain point continued growth requires the emergence of new kinds of units and of new types of arrangements between units. In short, it requires development.[6] Of course, growth does not sit back and wait patiently for development to occur. On the contrary, it provides the impetus for it. The pressure brought about by the quantitative increase of like units leads inevitably to a critical point at which the system must either fission or advance to new levels of organization by undergoing a qualitative transformation.[7] If it is to continue to accommodate and integrate its increasing units successfully, the system must elaborate its structure. It must develop.

Applying this general principle to socio-cultural systems specifically, we can say that the elaboration of social structure is the response of a system to the stresses occasioned within it by the multiplication of its units. As human numbers increase, they stretch the capacity of the existing structure to accommodate them, and when this pressure exceeds the "elastic limits" of the system, it

5 "In ordinary speech, Development is often used as synonymous with Growth. It hence seems needful to say, that Development as here and hereafter used, means *increase of structure*, and not *increase of bulk*. It may be added, that the word Evolution, comprehending Growth as well as Development, is to be reserved for occasions when both are implied" (Spencer 1866: 133n.).

6 "Socially as well as individually, organization is indispensable to growth: beyond a certain point there cannot be further growth without further organization" (Spencer 1873:59).

7 See White (1959:281-283).

responds by giving rise to new practices and institutions; in a word, by developing.[8]

The best illustration of this process that comes to mind is the elaboration in Plains Indian social structure brought about by large periodic aggregations of population. During most of the year the several bands of a typical Plains tribe subsisted separately and acted independently of one another. Political organization within the band was minimal: there was a chief, but he had relatively little authority, and there was no council. Socio-ceremonial life was equally simple.

For the summer buffalo hunt, however, the dozen or more bands constituting a tribe came together and formed an aggregate of several thousand persons. This aggregate took on a tribal organization distinctly more complex than that of the band. The band chiefs now formed themselves into a council, and from among their members elected a paramount chief who exercised considerable authority. It was his responsibility to coordinate and direct the activities of the tribe as a whole, and in doing so he was assisted by the council and by the men's societies. Inactive most of the year, these societies re-formed when the entire tribe assembled and carried out activities that took place only at this time. One of these societies was designated to act as a police force, punishing violations of the strict rules that prevailed during the buffalo hunt as well as preserving order on the march and during the sun dance.

That the emergence of these structural features was a response to the organizational problems posed by supra-band aggregation is shown by the fact that every one of them—the tribal chief, the council, the men's societies, the police force, the sun dance organization—lapsed when the tribe broke up into its constituent units in the fall.

This mode of cultural transformation, which among the Plains Indians occurred abruptly, dramatically, and reversibly, takes place among all evolving societies, only more slowly, less obviously, and, oftentimes, irreversibly.

One further qualification remains to be made. It is that the units whose increase brings about structural change in society are not so much human organisms in and of themselves as they are individuals embodying cultural roles. It is as fathers, hunters, workers, warriors, traders, followers, debtors,

8 J. B. S. Haldane (1954:323) has noted that from an evolutionary point of view "comparative anatomy is largely the story of the struggle to increase surface in proportion to volume." We might paraphrase Haldane here and say that socio-cultural evolution is essentially the struggle to elaborate social organization in proportion to increasing population.

worshippers, etc., that growing aggregates of individuals affect and modify the social structure of their society. Thus, with sufficient customers to purchase his wares, a part-time craftsman becomes a full-time specialist. And when enough such specialists arise, guilds may be formed to coordinate their professional activities. Or, to cite another example, when enough people become sufficiently involved in trade as buyers and sellers, markets develop to facilitate economic exchange.

Cultural evolution, then, emerges from this discussion as something more than the continuous accumulation of simple increments. Instead, it shows itself to be an interplay between quantitative change and qualitative change, between growth and development. The existence of this interplay is not always apparent since growth and development are seldom exhibited as clearly alternating phases. In any society undergoing evolution quantitative change may predominate here, while qualitative change prevails there. But closely intertwined as they may be, growth and development are distinguishable processes. And if our aim is to work out the course of cultural evolution with any degree of exactitude, we must grasp this distinction and make it the basis of our analysis.

Bibliography

Carneiro, Robert L.
1962 Scale Analysis as an Instrument for the Study of Cultural Evolution. *Southwestern Journal of Anthropology* 18:149-169.

Carneiro, Robert L., and Stephen F. Tobias
1963 The Application of Scale Analysis to the Study of Cultural Evolution. *Transactions of the New York Academy of Sciences,* ser. II, 26:196-207.

Dumond, D. E.
1965 Population Growth and Cultural Change. *Southwestern Journal of Anthropology* 21:302-324.

Haldane, J. B. S.
1954 "On Being the Right Size," in *A Treasury of Science* (ed. by Harlow Shapley, S. Rapport and H. Wright), pp. 321-325. New York: Harper and Brothers.

Naroll, Raoul
1956 A Preliminary Index of Social Development. *American Anthropologist* 58:687-715.

Simmel, Georg
1902 The Number of Members as Determining the Sociological Form of the Group. I. trans. by Albion Small. *The American Journal of Sociology* 8:1-46.

SPENCER, HERBERT
1866 *The Principles of Biology,* vol. 1. New York: D. Appleton and Co.
1873 *The Study of Sociology.* New York: D. Appleton and Co.
1885 *The Principles of Sociology,* vol. 1, third ed. New York: D. Appleton and Co.
1886 *The Principles of Sociology,* vol. 2. New York: D. Appleton and Co.
TERRIEN, FREDERIC W., AND DONALD L. MILLS
1955 The Effect of Changing Size upon the Internal Structure of Organizations. *American Sociological Review* 20:11-13.
WHITE, LESLIE A.
1959 *The Evolution of Culture.* New York: McGraw-Hill.

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