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QUANTITATIVE SYSTEMS OF SOCIOLOGY

by Franz Adler, Department of Sociology, University of Arkansas

Recently the news appeared in the daily papers that some mathematicians had discovered the possibility of applying mathematical formulas to human and social phenomena. The implication was that now comprehensive mathematical systems for the description and prediction of all human behavior were available. Actually, the construction of such a system has been the final goal of many workers in the social sciences for almost a century and a half. Since Auguste Comte, many have thought that, some day, it would be possible to establish a system of a universal and unified science, covering the social phenomena as well as the physical and biological ones. And while there is quite a number of social scientists who do not believe that it will ever be possible to describe all social phenomena mathematically, either because they are too complex or because they are of some sort of non-quantitative nature, there is a still more sizable number of workers who try to find mathematical expressions for those parts of the social universe they have empirically studied. To them, an announcement like the one mentioned above must have come as quite a surprise.

When Sir Isaac Newton laid the foundations to what is now a system of physics, he was enabled to do so not only by his own genius and by his own informal observations of apples falling from trees, but also by the amount of quantitative knowledge which he found ready for his use in the works of Copernicus, Kepler, Galilei, and others. Inventors do not fall from heaven. They are the ones who find or fashion the stone that closes and makes the arch, that tops and completes the pyramid. This is true of scientific systems as well as of steam engines. The system builder like the engine constructor is tied to the state of the technology he finds when he starts building, only that in his case the state of scientific formulation is concerned while in the case of the mechanical inventor the state of tool making, power production, power transmission, etc. are the foundations that matter. The trouble with the recent mathematical systems which have been so highly advertised is that they have all been constructed without the benefit of a sufficiently well developed basis in mathematically expressed empirical knowledge, of social fact.

Thus, N. Rashevsky in his Mathematical Theory of Human Relations begins by drafting a quantitative formula concerning the influence of one individual upon another. In this formula he uses two variables: the "intensity of an activity" and "desire," which is, in its turn, determined in general by the past history of the individual. The book does not indicate how the values for these variables might be obtained. The present writer is by no means a protagonist of the operational definition as a method of defining concepts in qualitative discourse, but it seems quite useless to set up equations without being able to indicate any operation by which the numerical values of the variables can be determined. Rashevsky arbitrarily chooses the type of function relating the variables and does, of course, not know the

3) Ibid., p. 3 fr.
numerical value of his constants. Thus, all we have is an arbitrary relationship of unknowns, as far as the mathematics of the matter go.

Rashevsky calls his theory a deductive one. Still, it is based on some conceptions of the actual happenings among people. The author has consulted a few sociological treatises, but seems to rely mostly on his own common sense knowledge, general education, and some biological analogies. His book abounds in statements like the following: "It must be remembered that in the ultimate analysis any natural resource, used in any industry, comes from the land;" 5) "An individual may imitate another one, and if this individual engages in an activity, a', with an intensity, \( I' \), then the intensity, \( a \), of the activity of the first individual will be the stronger, the stronger the \( a' \);" 6) "Due to the difference between parents and progeny, the active industrial class in the United States gradually 'thins out'." 7) These statements are neither based on empirical research nor are they credited to any social scientist, they rather seem to represent the author's own views.

A deductive theory will most probably be useful only to the extent as it is founded on valid induction. Whether this original induction is formal or informal is not the point. But only induction of some sort (if we exclude supernatural inspiration) can be expected to lead to a realistic theory. Whatever the mathematical merits of the author may be, he should have consulted some sociologists (and there are some of them who are well qualified to talk to a mathematician) as to the available observational materials and as to available methods of measurement. The bare mathematical "let-this-be-that" cannot be expected to lead necessarily to formulas that can be applied to empirical events.

The second of the works cited in the initially mentioned press story comes from George Kingsley Zipf, 6) University lecturer at Harvard University, whose training and activities have been mostly in the field of speech and linguistics. The speculations of this volume, showing a brilliant power of imagination, start out from studies and findings in this field which demonstrate, as far as the present writer, a layman, can judge, thorough familiarity with subject matter and method.

The author, however, steps out from his familiar field into physics to borrow from there a principle which he somewhat modifies. In physics, this principle appears as an equation

\[
0 = \frac{d}{2} \sqrt{\frac{d}{dt}} t = 0, \text{ called the principle of least action.} 9)
\]

It is perhaps important to notice that the above equation is valid only if the total energy remains constant and the same over every varied path. It should also be noted that it yields a maximum rather than a minimum in some cases. 10) It has to be modified to be applicable to other problems than those of mechanics (see Fermat's principle of least time in optics) and offers special difficulties if the propagation of light is treated as a motion of corpuscles moving with the velocity of light. 11)

5) Rashevsky, op. cit., p. 168.
6) Ibid., p. 4.
11) Lindsay and Margenau, op. cit., p. 125.
Transposed into the fields of biology and the social sciences this principle of least action is universalized without any restriction or condition as a principle of least effort, and the author claims that it will facilitate a systematization of an exact science of living behavior, that it will provide an objective language for the impersonal discussion of social problems, and that finally it will fulfill the need for a way in which man can explain the ways of God to man. It will be recalled that the original inventor of the principle of least action in physics, Maupertuis, in 1750 had a purpose similar to Zipf's in wanting to prove the existence of a creator God. The principle of least effort says that each organism will adopt a way of matter-energy output that will involve the expenditure of the probable least average rate of work. The organism will choose this way on the basis of its or its species' past experience according to its own insight and ability. Obviously such a broad principle cannot easily be put into mathematical terms and the author has not attempted to do so, thus actually disqualifying himself for the claims made for him by the press report.

That the author is in foreign waters in the social sciences becomes apparent, for example, by his treatment of what he describes by the phrase "tools-seek-jobs-and-jobs-seek-tools". The whole question of the means-quality of ends and the ends-quality of meaning is left open. As a result we get an enormously expanded "economic man" - not to mention all the economic mice, rats, trees, and algae - not understood as a construct, but as concrete description and explanation of all human actions, economic and otherwise. Obviously, actual human behavior does not follow always and everywhere an economic principle of least effort. Men indulge in sports for no other purpose than to expend effort, they overindulge knowingly in efforts of so-called amusement, they even commit suicide. Zipf does not face these difficulties of his view squarely, but endeavors to overcome them by adding additional assumptions to his structure whenever the occasion arises. Thus, for example, he takes care of the problem of suicide by postulating "a self-preserving 'something' in an organism which can eventually wish to escape into some other situation which is comparatively less frustrating in terms of some frame of reference." The "something", reading of previous and following passages leads us to understand, is an "identity point", which in Zipf's discussion starts out as "a movable mathematical point in time-space", but which in the course of the argument becomes a very definite, though not tangible, thing.

As a whole, Zipf's work can hardly be considered as a scientific contribution to the social sciences, much less as their mathematical systematization. The author of the newspaper report must be excused for having succumbed to the Harvard title of the author and the learned sounding verbiage of the work.

Quite on a different level appears the work of Norbert Wiener. Wiener does not try to transplant physical and biological concepts or methods by a priori reasoning upon universes of

12 Zipf, op. cit., pp. 648f.
13 Ibid., pp. 69f and passim.
14 Ibid., p. 7.
16 Zipf, op. cit., p. 243.
17 Ibid., p. 212.

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mechanical calculator brain. He finds that it is possible to describe certain processes common to certain machines and to the human brain. He finds that a mathematical theory will be essentially the same in describing processes of mathematical or logical computation, no matter whether these computations are performed by a mechanical calculator or by a human brain. And the study of the actual phenomena carried on by his medical and engineering associates shows that the similarity is not only one of function but one of structure too. This is important to remember so as not to confuse Wiener’s theory with reasoning by analogy. His is a theory arrived at by induction in which several formerly separate fields are united into a new unity.

Wiener’s inductive method is also the reason why he did not advance to a theory of society. He is aware of the lack of relevant quantitative data in this field. And he puts his finger with a rare degree of insight directly on the reason for this lack of data: “Thus the human sciences are very poor testgrounds for a new mathematical technique: as poor as the statistical mechanics of a gas would be to a being of the order of size of a molecule, to whom the fluctuations which we ignore from a larger standpoint would be precisely the matters of greatest interest.” 19) This is exactly the reason why quantitative research of purely theoretically important matters has been neglected in favor of inquiring into matters of immediate practical importance. That the latter types of research do not add much in terms of advance toward a mathematical theory of society is not further surprising.

Wiener’s well founded reluctance to enter a field in which he did not feel at home and which did not offer him sufficient data must be highly commended. At the same time it becomes necessary for the sociologist to ask himself whether this situation could not possibly be remedied. Is it conceivable at all that sociologists produce data which might serve as the raw material for the mathematical system builder?

The first question to be asked is what kind of data could be appropriate for the setting up of a quantitative theory. It is obvious that they will have to be quantitative, but how will it be possible to distinguish relevant quantitative data from irrelevant ones? This, it seems, can be done only on the basis of a hypothesis. This hypothesis will have to be a qualitative one. Any qualitative system of sociology could conceivably serve this purpose.

This is not the place and there is not the time to discuss all the systems of sociology which have been suggested at various times. Be it enough to state that the present writer is most strongly indebted to the Wiese-Becker 20) system and uses it as the starting point for his own. To be useful as a basis for the planning of research which is to lead to the setting up of a quantitative system, a qualitative system must, it seems, fulfill two main requirements:

1. All concepts of the system must refer to directly or indirectly observable data and combinations of such data. Such data are, at least conceivably, measurable or countable.

19) Ibid., p. 34; cf. also pp. 181 ff.
20) Leopold von Wiese, Systematische Soziologie, on the Basis of the Beziehungs and Gebildelehre, adapted and amplified by Howard Becker, New York, John Wiley & Sons, Inc., London, Chapman & Hall, Limited, 1932. This reference should, however, not be construed to mean that Wiese and Becker carry any responsibility for the present writer’s concepts.
2. All concepts of the system must refer to the same kind of data. By choosing a focus of interest and a level of observation the system becomes the system of a special science rather than a description of the whole universe or arbitrarily selected bits thereof. Also reference to the same kind of data assures the clarification of concepts and conceptual relationships. It becomes impossible to talk about the same phenomenon under several different names seemingly referring to several different subject matters.

Sociology has been defined as the science of social actions.21 The only data, then, to which any concept in this science is to have reference, are social actions. An action is to be understood in the widest sense as anything an organism does, including its persistence in a state of non-motion.22 Actions may be fully overt, that is they may consist of muscular movement and nothing else. Such actions, as for example, a hit in the jaw during a serious fight, are fully observable. Then there are actions which are completely covert, like thinking, seeing, hearing, feeling, etc. These remain unobservable and cannot as such enter sociological investigation. Finally, there are actions which are overt, but which are related to covert actions. These so-called symbolic actions are most important in social relationships.

It is not the task of the sociologist to study the relations among the various levels of action. This is done by the psychologist and the sociologist has to accept his findings. If the psychologist cannot or does not give him direct ways of connecting the overt to some covert actions, the sociologist will define the "meaning" of an action by its relation to the set of actions (or the "situation") in connection with which the action usually occurs. This set will include those actions which have been confirmed as occurring with high probability in connection with the action the meaning of which is to be determined. This procedure may enable the sociologist to leave out any reference to unobservable, covert actions. If a sentence, for example, occurs in a given situation after certain actions have occurred and before certain other actions do occur, and if such a use tends to recur with some regularity, an observer who does not know the language in which the sentence is spoken may nevertheless grasp its meaning.

Sociology, it was said, deals with social actions. An action is social if it is followed by an action of another individual. The action that follows must be of a kind that more or less regularly follows the kind of action the first action represented. Only due to this regularity of sequence we can and do claim a connection between the two actions.23

At first sight not all actions seem to be social. It is quite correct to state that people do things by themselves protected from any other presence by four walls and the darkness and the silence around them. Such actions are not only not social, but they are also not observable. Thus, they fall outside the field of a science which demands observable fact as its basis. Any action, however, occurring in the presence of another, is, as a rule, observed; the fact of observation alone makes the action a social one and all observed human actions are social actions.

21 Ibid., p. 65.
We have said that all phenomena dealt with by this science will have to be defined as social actions. The first concept so defined will be "culture". It consists of all the learned recurrent ways of acting that distinguish a population using them from populations not using them. If man would do anything by instinct, this would not enter into culture. But the psychologists assure us that everything man does is done in a learned manner, even breathing, digesting, cohabiting, etc. These ways of acting or recurrent actions occur more frequently among some peoples than among others. Thus they may be said to distinguish a population within which they occur often from one within which they occur rarely or never. Actions are connected with each other and occur in sequences and clusters. It is, then, naive to speak of a "sum of actions" making up a culture. Actions occur in arrangements like the parts of a machine which have to be articulated with each other to produce any effect. Such arrangements are known under the name of "culture patterns".

"Society" is defined as the network of social actions going on at any given time. It is a cross section through the cultural continuity. Thus, most of the actions found at the moment going on among and between individuals will be repetitions of previous actions. There will, however, be a few actions going on that may be new. These actions may later be repeated and thus become part of the culture, or they may not be repeated. These seemingly unique actions are the beginnings and the indicators of change. And the fact that such actions do occur more or less frequently compared to recurrent ones is also a characteristic of the culture.

Culture and society cannot exist without the existence of individuals. There have to be actors so that we may have actions. The individual interests us here as an actor only. As a physical phenomenon, as a biological organism, as a mixture of chemical substances he is not of interest. His actions, observed and typed, show certain regularities. These regularities in their relations to each other are the individual's "personality", that is the predictable actor. We may, for example, discover regularities in the relation of the individual's ways of overt and symbolic actions and may characterize him on this basis as a liar or an honest man, as consistent or inconsistent, as an optimist or pessimist, and we can thus predict with certain probabilities certain characteristics of his actions.

A personality, then, consists of the recurrent ways of acting of an individual. Culture, we have said, consists of the recurrent ways of acting in a population. There can be no action in culture that is not somebody's action. It is obvious that all and every individual's ways of acting are part of the culture. But are all actions within a culture part of somebody's personality? We have said that actions must be typed when they are observed. Accurate observation by itself reveals that no particular action is fully like any other particular action. We have, then, to decide on what basis we intend to consider actions as alike. No such typology has been worked out yet in this context.

It will be possible, of course, to get up a category of "traditional actions" or "ritual actions", etc. Thus, if we know that an individual has acted traditionally or ceremonially in previous situations, we may assume with some probability that another situation for which traditional or ceremonial ways of

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25) The lists of Leopold von Wiese (op. cit., pp. 134ff, and passim) or Florian Znaniecki (op. cit., pp. 135ff.) do not correspond to the present definitions and are far from exhaustive.
acting are available will also be dealt with by him in a traditional or ceremonial manner. On the other hand, if we have observed that the individual usually meets such situations by his own devices, we may predict that he will do so again. His traditional or untraditional behavior is part of his personality. Thus even a specific action which the individual will perform only once in his life, let us say, for example, acceptance of baptism or marriage, appears as part of his "ways of acting". We may conclude, then, that there is nothing in culture which is not in the personality of somebody in the population.

Culture was often thought of as being one set of patterns for every situation from which the individual could deviate only by breaking the law, the customs, the mores, etc., in other words, by putting himself outside of the pale of culture. Recent students of preliterate societies have reported that there is a wide range of behavior observable in every society with many gradations from the fully approved to the fully disapproved. We know, today, that we must distinguish between statistically normal behavior and the range of actual behavior on the one hand and idealized desirable behavior on the other. Our culture contains all kinds of patterns of business behavior, for example: from the Puritan small town New England business man to the protection or syndicate racketeer of Chicago or St. Louis, there are many kinds and variations of business men, but the Horatio Algers among them are relatively rare. Our culture, however, comprises all their ways of acting.

What is now the relation of personality and society? The actions that at any given moment constitute society are actions of individuals. They are either actions of a type previously performed by the individual or they are new. In the latter case they may be the beginning of new personality elements and new culture elements or they may remain unique and never recur. It is the number, frequency, and type of these new actions that will give us the probability and the probable direction of change.

It is fashionable today to define cultures as value systems. There is no objection to this if we define values in terms of actions. Any action is valuation. It is the only observable valuation. What a man does in a given situation is obviously what under the given circumstances he wants to do more than anything else. He may talk in one way and act in another which only means that he has one value for symbolic and another for overt action. A man's ways of acting are his values. The ways of acting of a culture are this culture's actual value system.

There are, however, symbolic systems observable in every culture which define cultural expectations. Expectations are ways of acting which have meaning by preceding certain actions of another individual. These ways of acting actually occur or may merely be talked about. Out of them a student of sociology can construct something that can be or may be used as a kind of cultural superego. In other words, reference to these ways of acting may be used as a lever for action, as a basis for propaganda. The fact that people in a culture think of themselves as having certain ways of acting does by no means prove that they do have such ways of acting, but it has been found that reference to these ways is a useful method of social control.

It is a grave error to assume that cultures do not change. Individuals are steadily changing their relations to other individuals and to things. A social relationship is to be understood as the recurrence of certain types of actions between or among some individuals for example Melville J. Herskovitz, Man and His Works, Alfred A. Knopf, New York, 1949, pp. 64, 484, 585, etc.
individuals and the probability that this recurrence will continue. Relations to things consist in the recurrence and probability of further recurrence of certain actions toward these things. Such relations change. They may be brought into being or they may be discontinued, they may be intensified (the probability of recurrence is raised) or they may be weakened (the probability is lowered). It may be possible to isolate series of actions by which such changes are brought about. These will be called processes. 27 Processes going on between individuals will change the society. If they lead to new types of relationships they will also change the culture.

It will be seen that such terms can be added in any desired number and they can be defined in a consistent manner. Thus we may define an institution as all the ways of acting around a culturally determined focus; we may define an establishment as all those actions within an institution that center around culturally distinguished individuals (as in case of any particular family) or things (as in case of a particular school or church); and so on. 28

What are we gaining by defining our terms in this way? It seems that they become accessible to quantitative research which was what we originally set out to achieve. But beyond that, we reach some immediate insights. If we say that personality, society, and culture consist of the same materials, namely the actions of the individual, we cannot hold that culture or society force the individual into the life he leads. They offer him choices which he may or may not accept. 28 If he refuses acceptance and introduces new ways of action, he changes, society and culture change too. If he changes alone, the change will be minimal. If he changes and his change is followed by many similar changes of others, the change in the culture and in the society will be noticeable. Other individuals may prevent him from performing certain actions, they may prevent others from following his new example. But they too are but individuals whose personalities are changeable — whatever their probability of acting in a certain manner may be, it is but a probability. It is the task of sociology to study concretely the types of action which in certain types of situations bring about certain types of changes rather than to moan fatalistically about the difficulty involved in changing the mores.