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Interdisciplinary Problems and Prospects

From its earliest times education has had a disciplinary basis. Aristotle's works, for example, exhibited a systematic survey of Greek knowledge under clearly defined categories and divisions, disciplinary in nature. The tendency to organize knowledge in this way has persisted down to the present. In recent times, however, counter-reactions to the increasing fragmentation and specialization of knowledge have occurred. Current trends include the establishment of undergraduate instruction in general education and broader fields for postgraduate study. Increasingly, colleges and universities offer courses transcending the boundaries of traditional departments to provide a more comprehensive viewpoint for the understanding of intellectual and social problems. Teaching programs in the liberal arts and sciences alike are frequently developed along interdisciplinary lines, and students now have opportunities to embark on entire courses of study free of the restrictions of orientation to single departments.[1] In the area of research, new forms of cooperation are emerging both within and outside the ordinary departmental structures. In government and industry, research teams are assembled whose members are drawn from a variety of disciplinary backgrounds. Within the universities, divisional administrative and organizational structures have replaced departmental ones in some academic institutions, and journals catering to less specialized intellectual and academic interests have been founded.

However, interaction between hitherto isolated disciplinary divisions in either teaching or research may be accompanied by a variety of problems. In this paper, some of the conceptual, behavioral, and administrative difficulties involved in the implementation of interdisciplinary programs will be identified and discussed.

conceptual problems

A preliminary requirement of any program of disciplinary collaboration is that the participants should be aware of and have agreed upon the type of collaboration: interdisciplinary, crossdisciplinary, multidisciplinary, or other.[2] John S. Matthiasson[3] has discussed some specific examples of programs which experienced severe difficulties due to uncertainty and misapprehension about goals or the proper mixture of collaboration and autonomy on the part of participating researchers. He showed how unconscious disagreement over the type of program led the participants to assume incompatible roles in the cooperative endeavor, with resultant failures in communication.

Even when the question of a common goal has been established, interdisciplinary programs must meet the charge of dilettantism. This is particularly true of doctoral students in newly-formed programs of interdisciplinary studies. Clearly, it is impossible for any individual to master comprehensively the component subjects of such interdisciplinary programs as criminal procedures (law, political science, psychology, anthropology), pollution control (physics, chemistry, geography, meteorology, biology, economics), urbanology (engineering, architecture, sociology, law, history), or race relations (genetics, sociology, history, literature). This is a matter of cutting the scholarly cake in a different dimension, not vertically and in depth as do the traditional disciplines, but horizontally through a number of related disciplines. If this method is legitimized through the establishment of appropriate academic structures, it may be less scorned, but the risk of neglecting the substance of knowledge still remains.[4]

Another obstacle arises from the basic differences in approach and methodology of cooperating disciplines. Again, if such differences go unrecognized, interdisciplinary ventures are in for trouble from the outset. Lloyd E. Ohlin described the bewilderment, frustration, and disappointment which attended the collaborative teaching and research programs involving students in sociology, social work, and law.[5] In each of these areas, essentially different intellectual capacities are valued for the performance of professional tasks. Sociology students are more concerned with conceptualizing problems, as evidenced by their preoccupation with research design and their desire to interpret problems as special cases of some higher generalization. Social work students, on the other hand, adopt a more empathetic approach, seeking to understand the psychological aspects of difficult cases and to identify with the specific problems of client groups. Law students, however, appear to be more concerned with analysis and spend much time in searching for the precedents on which to decide disputed

issues. These differences, which are sufficient to identify the existence of specific educational subcultures, are reflections of the sorts of intellectual values imposed on the students at early stages in their training. The academic future of the sociology student is largely determined by the skill and inventiveness exhibited in his doctoral dissertation, the supreme index of achievement. Prospective social workers, by comparison, are chosen for excellence exhibited in field work, while future lawyers are expected to display high abilities in reasoning and analysis.

The view that certain educational subcultures exist, with basically incompatible methodologies at their roots, has been elaborated in a model of university organization which identifies various "truth strategies" that guide the thought and action of certain groups.[6] According to this theory, there are four categories of truth strategies: *scientific* (maximum reliance on experience and codified reasoning), *direct* (high reliance on experience but a more specific approach to reasoning and evaluation of evidence), *analytic* (logically closed systems which emphasize codified reasoning at the expense of evidence and data collection), and *inspirational* (intuitive methods with little, if any, reliance on conventional techniques and experience).

Among the various problems of college and university administration dealt with in the truth strategy model, some reference is made to the difficulties experienced in programs of interdisciplinary studies which in turn are related to the different truth strategies. This intriguing suggestion is explored in an empirical study of faculty cultures by Jerry G. Gaff and Robert C. Wilson.[7] The central claim of this study, which appears to support the truth strategy approach, is that there are fundamental differences between faculty members in various fields of specialization that extend beyond subject-matter into areas such as educational values, teaching orientation, and life style. In general, the inference is that interdisciplinary ventures will have a greater likelihood of success when they attempt to merge humanities and social science subjects (direct, scientific strategies) than between subjects in the natural sciences, mathematics, and some professional areas such as engineering (scientific, analytic strategies). However, it should be pointed out that specific evidence of this conclusion is lacking, and it is rendered plausible only on the grounds of more general experience. At the same time, interdisciplinary cooperation within each of the cultures (strategies) can be encouraged. Plans to reorganize education along interdisciplinary lines are not likely to succeed unless administrators and educators become aware of the distinctions between faculty cultures and make conscious, deliberate efforts to minimize conflict arising from the lack of recognition of

the diversity of approaches to knowledge which these cultures incorporate.

A further obstacle to interdisciplinary cooperation is found in the terminology or jargon employed by particular disciplines.[8] While members of a single discipline may be in agreement as to the proper use of concepts, the same unanimity cannot be expected when those concepts are employed in the context of another discipline. For example, anthropologists and political scientists have quite different conceptions of "social structure." To diminish possible misunderstanding, considerable attention must be given in preliminary stages of interdisciplinary ventures to the discovery of common meanings or to a decision as to which of the cooperating disciplines will supply the basic linguistic concepts. Not only is some sharing of basic conceptual tools necessary if interdisciplinary collaboration is to be effective, but some effort must be made to establish common methodologies and investigative techniques.

Concern for matters of terminology must be accompanied by a deliberate effort to discard stereotyped ideas of disciplinary jurisdictions. Inflexible conceptions of the boundaries of traditional fields serve only to inhibit the expansion of knowledge rather than to enlarge it. Many individual academic researchers have not regarded departmental lines as barriers imposing prohibitions on their curiosity and on the work they do; nevertheless, interdisciplinary cooperation must be accompanied by painstaking attempts to remove these and other hindrances to effective communication which have arisen through the traditional isolation of the disciplines. While it is neither possible nor desirable to eliminate specialized terminology and methods entirely, the development of channels of communication that will encourage genuine cooperation between disciplines is a prerequisite. In this approach, not only will discipline insularity be broken down, but a greater awareness of the limits of interdisciplinary studies may be achieved.

The alleged incompatibility and diversity of approaches to knowledge, referred to in the discussion of truth strategies, is not absolute. In fact, unless that claim is modified in certain important respects, there would seem to be some insuperable difficulties in the establishment of interdisciplinary programs, whose ultimate aim is the integration of apparently disparate fields of knowledge. On the other hand, while it is easy enough to advocate that preconceived notions of disciplinary divisions should be overcome, it is desirable to reinforce this bland recommendation by outlining the basic requirements which must be satisfied if this end is to be achieved.

In order to bridge the traditional boundaries between diverse disciplines, it is necessary to have some creative insight into the application of the concepts and methods appropriate to one field to the subject-matter of another. A fruitful generative source for interdisciplinary ventures lies in the transfer of theoretical models from one field to another through the imaginative use of metaphorical or analogical types of reasoning. The enlargement of the understanding accomplished by this method goes far beyond the invention of appealing pictures and images. While purely metaphorical thinking may characterize the initial stages of dealing with problematical phenomena, the subsequent elaboration of early insights requires the sustained control of theoretical concepts in the superimposition of the structures of one system on another from a new point of view. Not only must there already exist some facts and patterns of regularities in the new field of investigation, but there must also be developed some explanations which will establish logical connections between them and the wider sphere of knowledge. In short, there must be a congruence or parallel between the conceptual and theoretical structures of the various areas of knowledge involved in interdisciplinary ventures. This compatibility of models will be expressed in various dimensions: a similarity of common descriptive elements based upon certain salient features of the respective cooperating disciplines, a uniform explanation in causal terms of the phenomena under investigation, and the verification of predictions of future perceptions. If these conditions are met, cross-connections between apparently diverse divisions of knowledge may be established with some hope of success. Not only may the structures of the new field and their relations be better understood, but unforeseen hypotheses may be devised and hitherto unnoticed consequences may be predicted.

In recent years, interdisciplinary activity has gathered momentum in the areas of the humanities, the social sciences, and the natural sciences. Many such ventures exhibit the presence of the general conceptual principles just outlined, and an indication of their scope can be gathered from the following selected illustrations.

Over the past two decades, the concepts of information theory, originally restricted to technical studies developed for communication media, have been applied to many different fields. In musical aesthetics, theorists have discovered that information theory, with its emphasis on syntactical structures and internal relations, often of a mathematical sort, can supply fruitful insights in the analysis and description of the creative process, musical structure and style, the aesthetics of musical perception, and the therapeutic uses of music in the treatment of psychological disturbances. Information theory

can also add considerably to the practical understanding of musical experience and its relation to more general experience.[9]

In another area of the humanities, a new stimulus to historical scholarship is provided in the *Journal of Interdisciplinary History*, whose inaugural issue announced the intention of encouraging interdisciplinary cross-fertilization through contributions from such related areas as economics, sociology, history of science, linguistics, data processing, psychology, and statistics. In addition, the *Journal* solicited contributions influenced by or emphasizing the techniques of anthropology, philosophy, paleopathology, psychoanalysis, zoology, art criticism, and numismatics.[10]

An increased awareness of the sterility of academic study divorced from the outside world has stimulated other social scientists to examine the problems and prospects of increased cooperation to deal with contemporary problems. The relative isolation of the fields of politics and economics in the universities, so thoroughly intertwined in the world at large, may be reduced if the conceptual and methodological differences which separate the disciplines can be overcome, perhaps by the establishment of an intervening discipline which will identify and relate their common roots.[11]

The problems of human behavior have been approached through the transfer of general explanatory models from one set of data to another. In social psychology, for example, the principles derived from cybernetics and engineering science have been adapted to the exploration of the human interaction aspects of task performance and to the analysis of leadership problems. There are many other instances of the crossing of disciplinary borders to establish a broader framework of analysis through the adoption of common aspects and methods. These include learning theory and personality theory in psychology as a source of influence on sociology, and the introduction of concepts from economic exchange theory into social psychological theory.[12]

Our understanding of animal behavior may be increased if the insights derived from the principles of ferromagnetism find a uniform application in the development of a theory of social imitation. Such apparently diverse phenomena as the movement of flocks of birds in flight, the alignment of fish in schools, the imitative behavior of fireflies, and the beating of the mammalian heart may submit to explanation in terms of this theory in future investigations.[13]

Remarkable progress in medical techniques is amply illustrated by the development of a new urological diagnostic device, the product of interdisciplinary cooperation between physicists, biomedical engi-

neers, and mathematicians. Adapting hydrodynamic principles and theories of flow in constricted tubes and jet breakup, this optical instrument analyzes the spectrum of drops into which the external urinary stream breaks up to provide statistics which can be used to map the delicate tubes of the urinary system. This technique, which permits early, painless diagnosis of obstructions in the urinary system, will have a potentially great effect on the health of hundreds of thousands of people.[14]

behavioral considerations

Many significant advances in knowledge have been made by the efforts of single individuals of profound curiosity and powerful creative intelligence whose work has transcended the limits of traditional boundaries. Distinguished researchers in the humanities, the social sciences, and the natural sciences frequently have extended their fields beyond the customary subject-matter without working as members of teams. Clearly, interdisciplinary work need not involve teamwork. Therefore, interdisciplinary programs, insofar as they entail the cooperative efforts of several participants, receive their justification on the pragmatic grounds that they are capable of accomplishing results of greater significance than would be possible through independent, uncoordinated efforts. Teamwork and interdisciplinary programs, of course, are not identical, for the former may involve the activities of several individuals in the same discipline. Nevertheless, a variety of interpersonal factors, such as reward, prestige, status, role, and leadership, may influence the effectiveness of both teamwork and interdisciplinary efforts.

One source of conflict stems from incompatible expectations of members of different disciplines regarding the source of prestige and rewards associated with interdisciplinary cooperation. Members of certain empirical disciplines, such as the social sciences, achieve rewards from the publication of treatises which involve the construction of elaborate conceptual frameworks, while pragmatically oriented disciplines, such as social work, are more concerned with policy or programmatic implications of the results of the research project.[15] The problem of devising ways to protect the prerogatives of individuals and to integrate their expectations of personal rewards with those accruing to the team as a whole is partly diminished by opportunities for individual discipline-oriented publication at the conclusion of a team project.

Uncertainties and disruptive tensions in teamwork situations may

result from role conflicts and role ambiguity when members of a team are unable to establish mutually satisfactory complementary role relationships.[16] Conflicts of this sort are often found between role expectation and role perception, and may be related to the divergent definitions of participating fields in interdisciplinary research and to the associated stereotyped ideas about disciplinary boundaries. For example, if a researcher is asked to perform a function in a program which does not accord with his conception of the proper function of his discipline, his conception of his role will differ from that of his colleagues. The obvious remedy is to exercise careful choice in the selection of team members. An attempt must be made to ensure that as complete an understanding as possible about the function and role of each individual is established before the project begins. This understanding must also be preserved throughout the life of the program through extensive communication between the director and the participating members. Other instances of role conflict and ambiguity may arise in situations of multiple authorship of research articles in professional journals and in situations where uncertainty is generated as to the status of participants either as co-workers or resource persons.

The concept of a "primary-group/secondary group continuum" proposed by Anthony R. Stone[17] provides a useful frame of reference for understanding the interpersonal dynamics of team relationships. Primary groups are characterized by intimate, face-to-face association, and cooperation is the common purpose of the group. In this setting, competitive passions are socialized by sympathy and mutual identification. Secondary groups, on the other hand, involve formal rules and regulations and provide a suitable environment for the protection of individual prerogatives. Status and role for each individual are determined contractually by the group leader. Secondary group processes may be viewed as a stage toward the development of primary group patterns. Stone's thesis is that ". . . the degree in which a research team approaches primary-group relationship patterns determines the long-range effectiveness of that group, with other things . . . being equal."[18] The implication for successful interdisciplinary teamwork interaction, then, is to develop a clearly structured situation from the beginning, with assigned status based on a recognition of the division of labour for all participants, supported by continuous communication about the postulates, methods, and goals of the research project.

How do interdisciplinary work groups distribute authority among themselves? Is democratic equality possible in the team research setting? At the outset, it must be realized that the notion of a leaderless

group is a contradiction in terms, since the establishment of leader and follower roles is a constant feature of dynamic social relationships. The description of leadership roles on the secondary group level is fairly obvious and needs no extended comment; leadership ordinarily is established contractually and by preliminary structuring of the group in such a way as to determine the assigned status of each participant. The designated status of leadership early in the secondary group stage, however, need not be identical with the achieved status at the later primary-group stage. The attempt to establish a purely democratic arrangement poses problems, particularly if the role of leadership is denied to any participant. At the same time, the conception of leadership does not necessarily imply a static condition in which one incumbent occupies the role of leader throughout the lifetime of the group. Since mature individuals can play a variety of roles, it is more realistic to suppose that the various participants in team research may have leadership potential for different stages in the life of the group, and provision should be made for its expression at appropriate times, relative to different problem-solving situations.[19]

Studies of leadership in small groups distinguish between the problems of the organization or group in achieving its purposes or goals, such as the acquisition of resources, their allocation, and the development of appropriate problem-solving techniques, on the one hand, and the problems relating to the maintenance and integration of the group on the social level, including the satisfactions of the personal needs of the members, such as the expression of emotional tensions, on the other.[20] This distinction between "task-instrumental functions" and "social-emotional functions" is thought to be the most fundamental type of role differentiation in small groups. Ideally, a small-group leader would be able to handle problems in both areas easily by a flexible type of behavior. However, the sociological reasons for the rarity of such individuals are related to basic differences in orientation: the interests of the task-specialist are more technologically oriented and his behavior towards this end requires continual adjustments on the part of the other participants. The social-emotional oriented individual, on the other hand, is more supportive of his associates in his reaffirmation of their values. He may be more motivated by a desire to be liked and may exhibit a reluctance to carry out certain tasks because of the threats such activities might hold for him. The task-oriented specialist may be acting defensively against the risk of involvement on the level of human feelings in his compulsive concentration on abstract problems. Disagreement among the members of a group about the role definition of the leader would make consensus impossible and lower the effectiveness of the group ac-

cordingly. The complex and paradoxical nature of the situation is revealed in Robert F. Bales' observation that "agreement on role definitions is thus hindered by rigid value systems at the very time when the inflexibility characteristic of specialists operating under these conditions makes this agreement all the more imperative."[21] Failing the emergence of an ideal leader who can fulfill both the task-instrumental and social-emotional functions, the pattern will more likely be one of specialization and complementarity in dual, mutually supportive leadership. This aspect of role separation has been a recurrent theme of recent research on leadership.[22]

Finally, some brief mention should be made of those intra- and inter-departmental conflicts, usually of a psychological or political nature, which influence the fate of interdisciplinary ventures. Within departments, stresses generated by opposing faculty orientations, such as teaching-versus-research, generalists-versus-specialists, educational liberals-versus-conservatives, and the like, may impede efforts to establish and maintain innovative academic programs, interdisciplinary or otherwise. Moreover, departments as a whole often exhibit patterns of behavior which closely resemble the territorial imperatives of the animal kingdom. The guild aspect of academic life — the orientation to the discipline versus the institution — serves as a protective device to preserve departmental boundaries against the intrusion of alien influences. Many universities harbor faculty members who regard the institution simply as a shelter where their careers as members of a particular discipline can be pursued. Much of the day-to-day rivalry between departments is a product of this attitude which is frequently reflected in disputes over curriculum policies and the like. Consequently, departments strongly afflicted with the guild mentality do not exhibit enthusiasm for extra-departmental ventures of the interdisciplinary sort.

administrative issues

In their discussion of the problems of university administration, Theodore Caplow and Reece J. McGee identify some mutually reinforcing trends in major universities: away from teaching towards research, away from undergraduate towards graduate instruction, and away from the general involvement of the faculty in curriculum towards specialization.[23] The interdisciplinary movement, they believe, is nothing more than a palliative for the more general problem, in spite of some isolated successful attempts to adapt departmental organization to undergraduate instructional programs and to a staff without strong disciplinary connections. It is clear that the main obstacle to the establishment and successful operation of interdisciplinary

ventures is related to the nature and function of the academic department as the most important and influential component in university organization. The power of the department lies in many features: it is the budgetary unit of the modern university, it is the essential point of identification for academic persons since it hires, appraises, promotes and grants tenure to them; it serves as the central marketplace for trading in prestige and status; and it functions as the area of intersection between the curriculum-centred university and the research-centred discipline. It is in some cases impossible, and in other cases only with great difficulty, that the interdisciplinary group can serve these functions without extensive alterations in the traditional structure of university organization.

Some forms of disciplinary collaboration would seem to have a greater probability of success, depending on the nature and extent of their ties with discipline-oriented departments. The objective of multidisciplinary cooperation is to serve a group of selected departments whose scholars work on problems associated with their own disciplines. In this situation, administrative functions are not strained, for governance can be carried out by an inter-departmental committee, with the director's prime function as that of coordinator. In an interdisciplinary context, however, the motivation for participation is different from that of the multidisciplinary sort; the successful design of solutions to a common problem takes precedence over attempts to advance the individual participant's standing in his own profession. Consequently, at least one of the motives for engaging in scholarly activity, that of status and prestige, is lacking. For this reason, experienced senior faculty members often display little interest in interdisciplinary programs. At the same time, participation in interdisciplinary projects is not the surest way for junior faculty members to secure recognition from a department responsible for decisions on tenure and promotion. From the administrative point of view, academic communities have found it much easier to administer multidisciplinary facilities which serve the requirements of existing departments than the needs of interdisciplinary groups whose ties with departments are minimal, at least for the duration of the project. Moreover, since the initiative for the establishment of new programs normally lies with the departments, this helps to explain why there have been few efforts to assemble and develop interdisciplinary groups.[24]

Inflexible budgetary systems may also inhibit the working of interdisciplinary programs. As mentioned earlier, the department is the budgetary unit and it is there that discipline-oriented loyalties and priorities take precedence. In the budgetary arena, politically strong departments gain at the expense of the weaker ones, leaving the still

less powerful non-departmental interdisciplinary units to scramble for the residues. Particularly in times of financial constraints, it is to be expected that the economic feasibility of programs not directly related to immediate departmental requirements will be questioned, given the additional expenditures of time and money involved. The creation of a special inter-departmental program with its own budget also introduces the problem of what to do with the staff when the program expires.

It should not be concluded, in view of the cautionary and somewhat pessimistic observation made in the course of this paper, that the future of interdisciplinary programs is necessarily dim. On the contrary, with a certain amount of internal readjustment, universities may react positively to pressures from without and from within to deal with intellectual and social problems on a more comprehensive basis. To enhance the probabilities of success of future interdisciplinary ventures, some requirements must be met. Most importantly, an environment must be provided which will be hospitable to joint efforts without permanent commitment. Consequently, administrative structures must be devised so that both departments and interdisciplinary centres may pursue a variety of objectives through interim joint appointments but without the subordination of one structure to another. Finally, a new breed of staff must be selected and rewarded, one which is willing and able to assume leadership for interdisciplinary programs. Ideally, the interdisciplinary centre, with its responsibility for building problem-oriented teams, will coexist with the discipline-oriented departments, the instructional and degree-granting units of the university. Decision-making in this context should exist within a framework of accountability rather than participatory democracy.[25]

It is clear that much thought will have to be given to the reorganization of the present administrative structures which are ill-adapted to the development of academic programs of an interdisciplinary nature. Some form of matrix structure is required in which vertical, discipline-oriented units are arranged with the horizontal, project-oriented units in such a way as to preserve an optimum relationship between autonomy and dependency. The matrix model is more adaptable to the complex contemporary environment since it is better suited to the realities of evolving organizations; moreover, it allows a greater variety of relationships between the component units and decision strategies appropriate to their diverse nature.[26] A complementary concept is that of a transdisciplinary structure, described by Jantsch,[27] which would coordinate the activities of all levels of the educational system, built on a feedback interaction between three types of units — systems designs laboratories, function-

oriented departments, and discipline-oriented departments — each supplying its appropriate version of education, research, and service.

summary recommendations

This paper began by identifying three main problem areas in the establishment of interdisciplinary programs — conceptual, behavioral, and administrative — and in the course of the discussion of central issues some general recommendations were made for their resolution. To conclude, it will be appropriate to mention some directions for future investigation within each of the three categories of problems. On the conceptual level, considerable philosophical and analytical work needs to be done on the epistemological foundations and methodologies of each of the academic disciplines, with particular attention to the question of the possible unity of knowledge as a whole, on either the large or small scale. Also, there is much need for investigation of the problems of teaching and learning within the interdisciplinary context from the philosophical and psychological points of view. To reduce communication barriers, possible grounds for common languages among various disciplines should be explored, a task for linguistics and applied mathematics. On the behavioral level, there is much room for work in the area of small-group dynamics in the specifically academic situation. Findings derived from studies in the non-academic world are not always directly applicable to the university settings. Finally, on the administrative level, there is a need for new types of organizational structures which will meet the demands of new conceptual developments and behavioral research findings. This is a task for theorists of systems of higher education or perhaps interdisciplinary workgroups in the field of higher education itself. The immense complexity and variety of these issues puts them quite beyond further discussion here. Nevertheless, until some significant advances are made towards the solution of these fundamental conceptual and pragmatic problems, the theory and practice of interdisciplinary ventures will remain only imperfectly understood.

footnotes

1. For example, an interdisciplinary Life Sciences and Environmental Studies Program was recently launched at Algoma University College. Drawing from the disciplines of physics, chemistry, biology, astronomy, geology, and geography, the course of study focused on the logically developing theme of living matter, its self-regulation and human regulations. However, plans to continue the program through its third year were abandoned due to financial constraints.

2. The following terminological distinctions should be noted. *Multidisciplinarity*: a flexible form of disciplinary association in which scholars share common facilities, research approaches, or environment, but each works on problems posed by his own discipline. *Pluridisciplinarity*: cooperative but uncoordinated arrangements between independent disciplines which are juxtaposed on empirical or pragmatic levels in order to enhance possible relationships. *Crossdisciplinarity*: researchers in one discipline seek new methodologies or solutions from another discipline through activity in areas of overlapping boundaries. *Interdisciplinarity*: an approach requiring intensive joint effort, cooperation, and a common sense of purpose and group responsibility, in which the methods and concepts of different disciplines are focused on a single problem or given project. *Transdisciplinarity*: a futuristic concept of a broad form of collaboration requiring the coordination of all disciplines, together with interdisciplinary systems, in an educational environment according to some common purpose and emerging epistemological pattern. See D. Alpert, "The Role and Structure of Interdisciplinary and Multidisciplinary Research Centers," Address to the Ninth Annual Meeting of the Council of Graduate Schools in the United States, Washington, D.C., Dec. 4-6, 1969; Erich Jantsch, "Inter- and Transdisciplinary University: A Systems Approach to Education and Innovation," *Higher Education*, Vol. 1 (1972), pp. 7-37; John S. Matthiasson, "My Discipline is Better than Your Discipline; Some Barriers to Interdisciplinary Research," *Canadian Review of Sociology and Anthropology*, Vol. 5 (1968), pp. 263-275.
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16. For some useful discussions of role theory, see: A. Paul Hare, *Handbook for Small Group Research*, New York: The Free Press of Glencoe, 1962; Robert L. Kahn, Donald M. Wolfe, Robert P. Quinn, J. Diedrick Snoek, and Robert A. Rosenthal, *Organizational Stress: Studies in Role Conflict and Ambiguity*, New York: John Wiley and Sons, 1964; David Moment and Abraham Zaleznik, *Role Development and Interpersonal Competence*, Cambridge, Mass.: Harvard University Press, 1963; Ralph H. Turner, "Role Standpoint and Reference Group Behavior," in *Sociological Theory*, L. A. Coser and B. Rosenberg, eds., New York: Macmillan, 1957.
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