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CONCEPTIONS OF SCIENCE AND ITS
INTERRELATIONSHIP WITH SOCIETY:
DOCTORAL CANDIDATES IN THE SCIENCES

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
Christopher K. Vanderpool
1966



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CONCEPTIONS OF SCIENCE AND ITS INTERRELATIONSHIP
WITH SOCIETY: DOCTORAL CANDIDATES IN THE SCIENCES

By
Christopher K. Vanderpool

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ABSTRACT

CONCEPTIONS OF SCIENCE AND ITS INTERRELATIONSHIP WITH SOCIETY: DOCTORAL CANDIDATES IN THE SCIENCES

by Christopher K. Vanderpool

Given the lack of a comparative perspective in the sociology of science and the lack of an adequate theoretical foundation for comparative research, the present endeavor is a search for concepts and hypotheses for future comparative research. Doctoral candidates from mathematics, physics, biology and psychology in a Midwestern University compose the population of this study. Interviews were conducted on the conceptions of the nature of science, the norm of commonality and internationalism, and the relationships of science and society held by these future scientists and the manner in which they perceive the present and future roles of scientists within the scientific community and society.. The results raise issues that can be resolved through future comparative and cross-cultural research.

INTRODUCTION

Historical Background. Since the initial development of the sociology of science as a hybrid of the sociology of knowledge and of the philosophy and history of science, science has been viewed as a social system by the four principal theorists in the sociology of science: Robert K. Merton, Talcott Parsons, Bernard Barber, and Norman W. Storer. In this pioneering effort, "Science, Technology, and Society in Seventeenth Century England",¹ and his classic essay, "Science and the Social Order",² Merton emphasized that science is a social institution which is related to other institutions in society and which is characterized by four institutional imperatives within its "autonomous" normative structure: universalism, commonality or communism, disinterestedness, and organized scepticism. Expanding upon the theoretical basis provided by Merton, Parsons dichotomized the normative structure of science into two sets of norms that governed 1) the pursuit of scientific knowledge (empirical validity, logical clarity, logical consistency, and the generality of the "principle" involved), and 2) the occupational role of the scientist (universalism, affective neutrality, specificity, achievement orientation, and the institutionalization of the scientist with reference to the collectivity).³ Bernard Barber attempted to synthesize the works of Merton and Parsons by providing several empirical referents for their generalizations while contributing to the theory of the sociology of science by examining the social functions of science and the consequences

for science and society of the relationship between science and society.⁴ Norman W. Storer, in the most recent contribution to the sociology of science, has explicated further the internal structure of science as an "autonomous" system of exchange governed by rewards and sanctions.⁵

Problems in the Sociology of Science: Toward a Comparative Perspective. At the institutional level of analysis, the sociology of science focuses on the relationships between science and other institutions in societies in which science is a "visible", more or less differentiated component of the social structure. Substantively, studies in the sociology of science illuminate the nature of these relationships and their effects on science and on the beliefs and expectations of the members of the scientific community, in particular, and on the social structure, in general. Theoretically, they can contribute to our understanding of the process of institutionalization, the systemic linkages between institutions, and the dynamics of total societies.⁶ However, as has been previously noted, the theoretical body of literature in the sociology of science has primarily focused on the internal structure of the scientific community and has only briefly touched upon the interrelationships between science and society. Thusly, the "autonomous" normative structure has been rigorously defined, elaborated, and reformulated in light of existing social theory. But the delimitation of the system-boundaries of the scientific community, the search for the systemic linkages between science and society, and the effects of

these relationships on science, the members of the scientific community, and society have not been theoretically or substantively articulated.

Secondly, the theoretical framework of the sociology of science has been developed out of the Western case and has assumed implicitly that the nature of the scientific community and science is essentially the same no matter what the societal context and is to a certain degree "a historical". Yet, in the historical context, we have comparative cases for the study of the relationships between science and other institutions, for example, Needham's classic work on the development of science in China and the structural changes that occurred as a result of the relationship between science and the political bureaucracy.⁷ We can study the international character of science which has been fundamental to it all through its history -- Alexandria in the Hellenistic world, Baghdad, and Azerbaijan were centers of international "communities" before the Middle Ages⁸ -- and the special problems posed for sociologists, who use societies as units of analysis, by an institution with a universal normative structure. The establishment of the "scientific role" in Europe, events such as the establishment of communication and transportation networks by French and English scientists during the 18th century while their nations were at war with each other,¹⁰ the "liquidation of the entire structure of French science" by the Jacobin convention in 1793 and the erection of a set of scientific institutions--Les Ecoles

Centrales, L'Ecole Normale, L'Ecole Polytechnique¹¹ -- provide the historical background for understanding the institutionalization of science in Western culture.

In addition to the study of historical social structures and the development of science in the West, contemporary Western societies provide another context for research in the sociology of science, e.g., the relationships between science and the polity and the impact of political control over the allocation of resources for basic and applied research, and the study of systemic linkages between institutions and the possible formation of new institutional structures. The developing nations provide still another, and neglected, context for the study of science and society. How is science institutionalized? What are, or what will be, the effects of the process of the institutionalization of science in the developing nations: 1) on the structure of science and the members of the scientific community within each nation-state, and 2) on the structures of other institutions and culture within each nation-state? What is the nature of the international scientific community in the modern world, and will it effect and / or be effected by the process of development, or modernization in these nation-states, and by the emergence of the nations of the world into a "post-modern" world? These are among the more salient problems for sociologists of science.

Given the lack of a comparative perspective in the sociology of science and the lack of an adequate theoretical foundation for

comparative research, the present research endeavor was constructed as an exploratory study, that is, a search for concepts and hypotheses to form a basis from which the scientific community could be viewed comparatively in future research. Utilizing the existing theory in the sociology of science as an initial point of departure, emphasis has been placed on the norms of science that govern not only the search for knowledge by members of the scientific community, but also those that regulate their role interrelationships within the scientific community, and between science and the other institutions of our society. Secondly, particular attention has been paid to the norm of internationalism, since the scientific community is an illuminating case of relationships across societies throughout history. Hence, we are concerned with the conceptions of the nature of science, the international scientific community, and the relationships of science and society held by members of the scientific community and the manner in which they perceive their roles within the scientific community and society. Through these means, it is hoped that a greater understanding of the interrelationship of science and society and the international scientific community can be attained.

METHODOLOGY

Population. We selected for our population doctoral candidates in the physical, biological, and social sciences for practical as well as theoretical reasons. Theoretically, the graduate student population is being socialized to the norms of science that will govern their search for knowledge and their relationships within and outside of the scientific community. As participants in a particular culture, they should reflect, cognitively and behaviorally, American culture, the norms of science, and the relationships between science and American institutions. Practically, the population was chosen because of status-equality and ease of establishing rapport between interviewer and interviewees. The pre-test verified our feeling that status difference between senior scientists and Master's level graduate students would affect not only the rapport between interviewer and interviewee, but also the type and quality of data obtained.

Stratified Sample. The pre-test revealed that there appears to be a "continuum" within the sciences of disciplines based on the "degree of involvement" of the disciplines in society, in terms of the dependency of the discipline on resources allocated by other institutions and in terms of the nature of the scientists's role in society. The continuum ranges from mathematics to the social sciences. Mathematicians dealing with a highly abstract subject-matter feel they do not

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depend on society for resources--all they need, as one mathematician phrases it, is a "cigar and a rocking chair" to pursue a problem. Physical and biological scientists believe that they depend heavily on outside sources for facilities, equipment, and financial support to conduct their research. Biological and social scientists, as students of the human organism, and of social and psychological phenomena, express a more involved relationship with society. Studies of human and animal organisms, genetics, and of social and psychological phenomena require the experimental manipulation of human beings and animals, but social and biological scientists contend that they are restricted in their pursuit of knowledge by the laws, moral codes, and ethical precepts of our society. Research that might be crucial for the advancement of knowledge often cannot be undertaken because it would involve the inhumane treatment of human and animal subjects. In addition, social scientists must enter into social relations with their subject-matter, while mathematicians and physical scientists can pursue problems by manipulating symbols and physical objects.

With the idea of exploring the significance of "degree of involvement" in society for science, we sampled from four disciplines--mathematics, physics, biology, and psychology. Our sample of psychologists was divided into two groups--clinicians and experimentalists. This division was made on the basis of the

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• Die Rolle der Literatur ist es, die Menschen zu informieren, zu unterhalten und zu inspirieren. Sie ist das Medium, durch das wir unsere Welt verstehen und gestalten können. Die Kunst ist das Medium, durch das wir unsere Welt darstellen und interpretieren können. Sie ist das Werkzeug, mit dem wir unsere Welt erschaffen und verändern können.

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• Die Rolle der Individuen ist es, die Menschen zu informieren, zu unterhalten und zu inspirieren. Sie ist das Medium, durch das wir unsere Welt verstehen und gestalten können. Die Kunst ist das Medium, durch das wir unsere Welt darstellen und interpretieren können. Sie ist das Werkzeug, mit dem wir unsere Welt erschaffen und verändern können.

continuum revealed in the pre-test. The psychologists interviewed felt that the clinicians were closer in orientation to the social sciences and more involved in society, while experimentalists were perceived to be more akin to physical and biological scientists.

The research design called for a non-probability sample of $N=48$, twelve respondents from each of the four disciplines. To draw our sample, we obtained lists from the departments of mathematics, physics, biology, and psychology at a large Midwest university of all doctoral candidates registered for the 1966 summer session. Except in mathematics, we randomly selected twelve names from each list, made our contacts by telephone and arranged interview sessions. Only six doctoral candidates were registered in the department of mathematics and we tried to secure all six--we were able to interview five. After randomly selecting alternates from a list of eighteen doctoral candidates in physics, eleven physicists were interviewed only in biology and psychology were we successful in obtaining twelve respondents. The total sample, then, was an N of 40.

Technique and Coding. Because of the exploratory nature of our research, we felt that the open-ended interview would be the most appropriate data-gathering technique for sensitizing us to the important sociological variables that need to

be considered in a comparative sociology of science. Given the lack of an adequate theoretical foundation from which meaningful questions could be formulated, and the lack of similar empirical studies, the open-ended interview schedule seemed the most feasible instrument for achieving the research objectives.

The coding schema was established by using the empirical categories generated in the responses to the first series of interviews. Some changes were made in the course of our re-research until a fairly stable set of categories were developed which allowed us to code directly during the interviews.

Standardizing the Interview Process. Since the data for this study were collected by two researchers working independently, certain standardizing procedures were necessary to insure data comparability. During the pre-test period we interviewed respondents together, independently, and with our fellow researcher present but not participating in the interview. These sessions apprised each of us to the interview "style" of the other. An open-ended interview schedule was constructed, and several additional interviews were conducted separately, taped, and compared. The final interview schedule was constructed with each question typed out in full, with words to be emphasized underlined, and probes specified. Tests of the comparability of our interview techniques, our use of probes, an

data collected were made during the pre-test period as well as at the research site. By the time we began our study, the interview procedures were sufficiently comparable to insure data comparability.

The Interview Schedule. The interview schedule was divided into three sections: "World view" --conceptions of science, of the relationships between science and society, and of the future; reference and membership groups; and the structure of the university. The original interview schedule contained seventy-seven questions. During the course of our research fifteen questions were eliminated because of overlap, because they were poorly formulated and confusing to our respondents, or because they proved to be meaningless for our respondents. No questions were added. The interview schedule we took into the field is included in the appendix--those questions which were eliminated are asterisked.

This essay will concentrate on the results obtained from the first section of the interview schedule, the "world view". The conceptions of science, the membership criterion of the scientific community, and the process of self-identification as scientists will be presented. Then conformity to the norms of commonality and internationalism will be discussed. The final section deals with the conceptions of the interrelationship of science and society in the present and in the future.

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CONCEPTIONS OF SCIENCE

Crucial to an understanding of the institution of science and its interrelationship with the other institutions of the social structure are the conceptions of the nature of science held by the members of the scientific community. They form the basis on which scientists are oriented to the collectivity and the perspective from which they view the systemic linkages between the institutions of our society. Moreover these conceptions define the nature and purpose of the scientific community and the role of its participants, and delimits its boundaries.¹² These internalized values establish the criterion by which members of the scientific community evaluate their position and that of others within and outside the collectivity. Before an account can be given of the interrelationship of science and society, then, these conceptions of the nature of science must be discussed.

Nature of Science and the Membership Criterion of the Scientific Community. Norman W. Storer maintains that creativity (the ability to produce novelty that is meaningful and important to the creator and others) is the essential element within the conception of the nature of science held by the members of the scientific community.¹³

He points out that it

. . . is a scientific ideal and . . . the normative structure of science is oriented toward this ideal rather than toward a description of empirical reality. . . . So long as the interaction among scientists places a premium upon creativity, we may assume that they tend--while in the role of the scientist to accept this as their major professional goal. The importance of creativity is, in effect, built into their universe of discourse; in order even to converse as a scientist, one must implicitly accept this goal. ¹⁴

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2. The second part of the document outlines the specific procedures for recording transactions. It details the steps involved in the accounting cycle, from identifying the transaction to posting it to the appropriate ledger account.

3. The third part of the document discusses the importance of reconciling accounts. It explains how regular reconciliations help to ensure that the records are accurate and that any discrepancies are identified and corrected promptly.

4. The fourth part of the document discusses the importance of maintaining proper documentation. It emphasizes that all transactions should be supported by appropriate evidence, such as invoices, receipts, and contracts.

5. The fifth part of the document discusses the importance of maintaining proper internal controls. It explains how internal controls help to prevent fraud and ensure the accuracy of the financial records.

6. The sixth part of the document discusses the importance of maintaining proper communication. It emphasizes that all parties involved in the financial process should be kept informed of the status of the records and any issues that arise.

7. The seventh part of the document discusses the importance of maintaining proper security. It explains how proper security measures help to protect the financial records from theft, loss, and damage.

8. The eighth part of the document discusses the importance of maintaining proper confidentiality. It emphasizes that financial records are often sensitive and should be kept confidential to protect the interests of the organization.

9. The ninth part of the document discusses the importance of maintaining proper accuracy. It explains how proper accuracy is essential for the reliability of the financial records and for the ability to make informed decisions.

10. The tenth part of the document discusses the importance of maintaining proper consistency. It emphasizes that the records should be maintained in a consistent manner to ensure that they are comparable over time and across different periods.

Hence, if creativity is the scientific ideal toward which the normative order of science is oriented, it should be a key element in the definition of the nature of science and of the membership criterion within the scientific community held by all scientists. Whether or not this theoretical statement is applicable to the sample can be shown by the range of responses to two questions: 1) what is science?, and 2) what makes a man a scientist?

The doctoral candidates define the nature of science either as a method, a study of the physical or natural world, or a creative cognitive style of inquiry. Science as a method is regarded as a "systematic process of reasoning which starts from axioms and deduces from these."¹⁵ Irrespective of discipline, 37.5% conceive of science as a method of inquiry. A higher proportion, 42.5%, view science as a study of the physical or natural world, that is "a search for objective knowledge of physical and social reality." From all the disciplines, only two physicists regard science as a only a study of physical reality and not of the natural world (physical and social reality). The remaining 20% of these future scientists agree with Storer's theoretical position by considering science as "being creative in an objective search for knowledge." In other words, science is a creative cognitive style.

Viewing the results from the perspective of the disciplines sampled, 63% of the physicists define science as a study of the physical or natural world. This percentage is larger than in any other discipline for this category of responses. Most of the experimental and clinical psychologists conceive of science as a method. In contradistinction, 42% of biologists view science as a creative cognitive style. Mathematicians are equally divided between regarding science as a method and as a study of the

Table 1: Disciplines and the Conceptions of Science

Conceptions of Science:	Disciplines					Total
	Mathe- matics	Physics	Biology	Experi- mental Psychology	Clinical Psychology	
Scientific Method	40%	27%	25%	50%	66%	37.5%
Study of Physical or Natural World	40%	63%	33%	33%	17%	42.5%
Creative Cog- nitive Style	20%	---	42%	17%	17%	20.0%
Total	<u>100%</u> (N=5)	<u>100%</u> (N=11)	<u>100%</u> (N=12)	<u>100%</u> (N=6)	<u>100%</u> (N=6)	<u>100.0%</u> (N=40)

Table 2: Disciplines and the Conceptions of the Membership
Criterion in the Scientific Community

Conceptions of the Mem- bership Cri- terion in the Scientific Community	Disciplines					Total
	Mathe- matics	Physics	Biology	Experi- mental Psychology	Clinical Psychology	
Scientific Method	40%	64%	67%	66%	66%	62%
Creative Cog- nitive Style	40%	27%	25%	17%	17%	25%
Other	20%	9%	8%	17%	17%	13%
Total	<u>100%</u> (N=5)	<u>100%</u> (N=11)	<u>100%</u> (N=12)	<u>100%</u> (N=6)	<u>100%</u> (N=6)	<u>100%</u> (N=40)

physical or natural world.

When one compares the above results to those obtained from a search for the membership criterion of scientific community (what makes a man a scientist), a change occurs in the range of responses. Sixty-two percent of the sample maintain that the use of the scientific method determines one's inclusion within the scientific community. Physicists and biologists exhibit the greatest changes in their responses, while the clinical and experimental psychologists remain relatively stable. Mathematicians conceive of the membership criterion either as a creative cognitive style or as the use of the scientific method. Hence, the greater the emphasis placed by a discipline on defining science as a method, the greater the equivalence between the conceptions of the nature of science and of the membership criterion of the scientific community.

The stability of the psychologists' responses are a function of exposure to a common frame of reference early in the process of socialization to the profession. Even though there is a considerable amount of friction between clinicians and experimentalists at the graduate and professional levels, the majority of psychologists are initially socialized to the same set of propositions about the nature of science and the scientific community. As one psychologist stated,

I cannot think of any introductory course in psychology which does not emphasize that psychology and the other social sciences are sciences by virtue of their use of the scientific method. Whoever heard of courses in chemistry or physics that explain what the scientific method is? We're more concerned about people not calling us scientists, than going out and doing science.

This also explains why psychologists tend to define science as a method or a creative cognitive style rather than a study of the natural

or physical world and consider the former as the membership criterion within the scientific community.

The absence of the emphasis on defining science and the scientific method in the early stages of the education of future scientists in the other disciplines are partially responsible, then, for the discrepancies in the responses of biologists, physicists, and mathematicians between Table 1 and 2. The high percentage of agreement within each table, however, implies that there are certain beliefs commonly shared by them regardless of specialization. For the physicists, it may be that their agreement over a definition of science is a product of the subject matter they are engrossed in and the emphasis placed by textbooks and teachers on the physical or natural world as the proper realm of their pursuit of knowledge. With a different stress and subject matter, the same may also apply to the mathematicians and biologists.

Viewing the results from an aggregate perspective, there is a considerable difference between the manner in which the respondents define science and specify the membership criterion of the scientific community. In the former, the object of science is emphasized; the method of scientific inquiry in the latter. Creativity is a crucial factor in the conceptions of science of only a minority of the respondents. Hence, it is not the scientific ideal toward which the majority of these doctoral candidates are orientated.

Self-identification as Scientists. Sixty-eight percent of the sample consider themselves members of the scientific community. The most frequent rationale for their self-identification as scientists pertain to their evaluation of their performance of the scientific role as established by their conception of the membership criterion within the scientific community. Only 10% of the respondents, two in Biology

and two in Clinical Psychology, do not regard themselves as scientists.

The biologists, who specialized in taxonomy, doubt the correspondence of the taxonomic method and the scientific method. Since experimentation is regarded by them as the essential core of the scientific method, they perceive the classification of biological phenomena in a logical system as peripheral to science. The clinical psychologists, on the other hand, assert that the subject matter they are concerned with and the specific methods utilized by their discipline are in conflict with the nature of science. As one psychologist stated,

No, I am not a scientist because I'm in clinical psychology. It is not a science, but an art of understanding people. Secondly, in the area that I am in, one does not adopt the scientific method in studying human phenomena.

In every discipline, several doctoral candidates rank themselves as aspiring scientists. They believe that they have not acquired sufficient command over the tools of their discipline to function in the scientific role. In several cases, these aspiring scientists indicate that they have not met one of the ends of science, i.e., they have not contributed to the growth of scientific knowledge, because of a lack of ability in using the method of scientific inquiry. Over half of the mathematical classify themselves within this category and foresee the continuation of this role past their doctoral degree. Possibly by the time they have finished post-doctoral training, they will have acquired the necessary ability to function in the role of a scientist.

Underlying the self-identification of the doctoral candidates with the role of a scientist, then, is their evaluation of their use of the scientific method. It is their criterion of membership within

the scientific community. Figure 1 portrays this process of self-identification. The degree to which an individual regards his discipline or specialization as using the scientific method in its research and judge his ability with the scientific method as adequate determines his self-identification as a scientist. If these are congruent with the criterion of membership within the scientific community, he will identify positively with the role of a scientist. On the other hand, if

Figure 1: Self-identification as Scientists:
Congruence of Discipline or Specialization and
Ability with or use of the Scientific Method and
the membership Criterion of the Scientific Community*

Self-identification as Scientists:	Discipline or Specialization	Ability with or use of the Scientific method
Positive	+	+
Aspiring	+	-
Negative	-	-

Number of Cases:

Positive-----	27
Aspiring-----	9
Negative-----	4
Total	<u>40</u>

*A "+" implies congruence with conception of the membership criterion of the scientific community, while a "-" indicates incongruence.

he considers his discipline or specialization as congruent but judges his ability with the scientific method as inadequate at the moment, he will perceive his position within the scientific community as that of an aspiring scientist. Finally, if he regards his discipline or specialization as incogruent and believes that he does not use the scientific method, he will negatively identify with the role of a scientist.

COMMONALITY AND INTERNATIONALISM

In the introductory remarks of this essay, the elements of the normative structure of science, as conceptualized by Merton, Barber, Parsons, and others, were outlined. Two of these norms are commonality and internationalism. Commonality may be defined as ". . . the non-technical and extended sense of common ownership of goods. . ."¹⁶ It requires that every scientific finding becomes part of the cumulative body of scientific knowledge. The norm of internationalism, on the other hand, prescribes that all scientists recognize the international character of science, that is, the transcendence of the scientific community across cultural and political boundaries. It demands that all individuals who perform the role of a scientist to: 1) be considered as members of the scientific community regardless of their religious, ethnic, and racial origins and their citizenship in a nation-state, and thusly, 2) share in the cumulative body of scientific knowledge.

Theoretically at the ideal level, these two norms are interrelated. If internationalism exists, it requires a free flow of communication between scientists throughout the world. On the other hand, if commonality exists, it infers the incorporation of scientific findings into the corpus of scientific knowledge by all scientists. A violation of either of these interrelated norms, then, is theoretically a violation of the other.

Normative Conformity. Conformity to the norm of commonality can be measured by the responses of the doctoral candidates to two questions. They were asked: 1) to ascertain what is the role of the scientist in wartime, and 2) to express their views on secrecy within the scientific

community.

Responses to the first question fall into one of two categories. Some doctoral candidates assert that scientists should maintain the same role performed by them in peacetime, while others recommend a supportive role in the war effort. Continuance of the same role in wartime as in peacetime is perceived to be conformity to the norm of commonality; for a supportive role necessitates secrecy which, as Merton points out, is a violation of this norm.¹⁷ The endorsement of secrecy as a response to the second question, then, is regarded as nonconformity to the norm of commonality. If a respondent maintains that secrecy should not exist at anytime within the scientific community, his or her response is judged as compliance to the norm.

Aggregate results reveal a tendency towards nonconformity with reference to the role of scientists in wartime. Fifty-five percent of the sample believe that scientists should perform a supportive role in the war effort. There is, however, a definite gap between disciplines in conformity to commonality. Both the clinical and experimental psychologists conform to the norm. Mathematics, physics, and biology, on the other hand, have the highest frequencies of nonconformity. The sample from these disciplines contend that since their research can be applied militarily, scientists should perform supportive roles in the war effort. The difference in conformity and nonconformity between psychology and the other disciplines, then, is a result of the military potential of the research conducted by the disciplines.

During the Second World War, the government relied heavily on the research of mathematicians, physicists, and biologists to preserve the nation's military superiority over the enemy. Physical and biological

Table 3: Disciplines and Conformity to the Norm of Commonality:
The Role of Scientists in Wartime and Secrecy*

	Disciplines					Total
	Mathe- matics	Physics	Biology	Experi- mental Psychology	Clinical Psychology	
The Role of Scientists in Wartime:						
+	20%	27%	42%	67%	83%	45%
-	80%	73%	58%	33%	17%	55%
Total	100%	100%	100%	100%	100%	100%
Secrecy:	(N=5)	(N=11)	(N=12)	(N=6)	(N=6)	(N=40)
+	60%	9%	42%	67%	33%	38%
-	40%	91%	58%	33%	67%	62%
Total	100%	100%	100%	100%	100%	100%
	(N=5)	(N=11)	(N=12)	(N=6)	(N=6)	(N=40)

* A "+" indicates conformity to the norm of commonality and a "-" nonconformity.

Table 4: Military Potential and Conformity to the Norm of Commonality:
The Role of Scientists in Wartime and Secrecy*

	Military Potential			Military Potential	
	High	Low		High	Low
The Role of Scientists in Wartime:			Secrecy:		
+	32%	75%	+	32%	50%
-	68%	25%	-	68%	50%
Total	100%	100%		100%	100%
	(N=28)	(N=12)		(N=28)	(N=12)

$Q = -.74$; $\chi^2 = 8.09$,
d.f. = 1, $p = .01$

$Q = -.36$; n.s.

* Throughout this essay, Yule's Q will be used as a measure of association. for an explanation of its meaning and the formula for its computation, see Morris Zelditch, Jr., A Basic Course in Sociological Statistics, New York: Holt, Rinehart, and Winston, 1959, pp. 168-171. For an example of its use in a study in the sociology of science, see Warren O. Hagstrom, The Scientific Community, New York: Basic Books, 1965.

scientists were recruited by the military in greater numbers than the social scientists.¹⁸ Since the war, they have received a greater amount of federal grants to support their research. The majority of these funds were obtained through federal granting agencies who in turn received five-sixths of their appropriations from the military.¹⁹ If the amount of funds obtained directly and indirectly from the military and the number of scientists participating in the military institutions are used as indices of military potential, the research of mathematicians, physicists, and biologists have a high potential for military application and the psychologists a low potential.

When the disciplines are divided by this distinction, a measure of association of $-.74$ is obtained indicating that military potential is negatively correlated with conformity to the norm of commonality with reference to the role of scientists in wartime. To a lesser extent, it is also negatively correlated to commonality in the question on secrecy.

Sixty-two percent of the sample, regardless of discipline, approve of secrecy. Again those disciplines having high military potential deviate from the norm of commonality to a greater extent than those having low military potential. Across disciplines, however, the doctoral candidates admit that theoretically and ideally there should be conformity to the norm of commonality, but at the practical level they contend this is impossible. Pressure from within and outside the scientific community produce nonconformity.

The increased size of the scientific community and the competitive spirit, created through the great emphasis placed on publications as an index of contribution to scientific knowledge, lead to a fear of being anticipated on the part of the respondents. They feel it necessary to cover their research in a cloak of secrecy to prevent other scientists from "scooping"

the results of their experiments and thusly reaping the scientific rewards that are entitled to them

For reasons of international prestige and self-reservation, these future scientists believe that society pressures scientists to deviate from the norm of commonality. As a result of it tremendous applied social value, science has become a "commodity" in the ideological race for the scarce resource of international prestige. Not only do societies wish to enjoy the comforts made possible by the technological innovations created in and through science, but they want their own political boundaries. It is a "game of 'one-upsmanship' in which everyone counts how many Nobel Peace Prize winners he has in his corner." This also applies to research that has military potential. Since some nations seek to maintain not only an adequate defense system but a superior one; nothing could be more dangerous to the selfpreservation of a nation than the communication of the results of scientific experiments that might enable an enemy to develop a greater warehouse of destructive weapons. Hence, the doctoral candidates believe that there are restrictions placed on the flow of communication to scientists of other nations and pressures placed on the nation's scientific community to sanction the labeling of certain research as "top-secret".

As marked earlier, a violation of the norm of commonality implies a violation of the norm of internationalism. The results presented above indicate a tendency of deviation from the former norm and greater non-conformity in those disciplines with a high military potential. This trend should continue to exist, then, with reference to the norm of internationalism.

The responses of the doctoral candidates to two questions can be used as an index of conformity to the norm of international scientific conferences should be held during wartime. A "no" response to either of these questions is viewed as a deviation from the norm and a "yes" response as conformity.

None out of ten conform to the norm of internationalism when they posit the existence of an international community of scientists. To a minority, this international body includes only those scientists involved in research on a specific problem, and/or within one area of specialization or discipline, or only the elites of discipline. The majority, however, perceive the international community as spanning all disciplines and specializations and including all scientists. In the case, the primary function of this international scientific community is the transfer of information between scientists and the addition of new findings to the body of scientific knowledge.

According to the doctoral candidates, international communication enables scientists to be aware of other scientists who are working on similar problems, averts the needless repetition of discoveries, and acts as a stimulus to the growth of science. In addition, it serves as a means of cohesion within a discipline or specialization by preventing the isolation of its members, establishing agreement over a classificatory system of concepts, and focusing the attention of its members on a common set of problems.

With reference to the maintenance of international scientific conferences during wartime, aggregate results reveal that nine out of ten conform to the norm of internationalism. They endorse these international meetings on the grounds that: 1) if these meetings are not held, the

Table 5: Disciplines and Conformity to the Norm of Internationalism:
Existence of an International Scientific Community and the
Maintenance of International Scientific Conferences in Wartime

	Disciplines					
	Mathe- matics	Physics	Biology	Experi- mental Psychology	Clinical Psychology	Total
Existence of an In- ternational Scientific Community:						
+	100%	100%	92%	83%	100%	95%
-	---	---	8%	17%	---	5%
Total	100% (N=5)	100% (N=11)	100% (N=12)	100% (N=6)	100% (N=6)	100% (N=40)
Maintenance of Interna- tional Sci- entific Con- ferences in Wartime:						
+	60%	82%	100%	100%	83%	87%
-	40%	18%	---	---	17%	13%
Total	100% (N=5)	100% (N=11)	100% (N=12)	100% (N=6)	100% (N=6)	100% (N=40)

Table 6: Military Potential and Conformity to the Norm of Interna-
tionalism: Existence of an International Scientific Com-
munity and the Maintenance of International Scientific
Conferences in Wartime

	Military Potential			Military Potential	
	High	Low		High	Low
Existence of International Scientific Community:			Maintenance of International Scientific Conferences in Wartime:		
+	96%	92%	+	86%	92%
-	4%	8%	-	14%	8%
Total	100% (N=28)	100% (N=12)		100% (N=28)	100% (N=12)

Q= +.42; n.s.

Q= -.29; n.s.

progress of science will be jeopardized due to the restrictions placed on international scientific communication; and 2) the maintenance of these meetings will assist the efforts to establish peace by providing channels of communication into the warring nations. The nonconforming minority oppose this viewpoint. They believe that open communication between scientists will lead to the diffusion of scientific findings to the enemy and be harmful to our nation's security. Only if restrictions are placed on the type of information disseminated will they agree to the establishment and maintenance of international scientific conferences in wartime.

To both questions on internationalism, then, there is conformity to the norm. As a result, military potential is not negatively correlated to the norm of internationalism to the same degree as it was with the norm of commonality. It has a positive correlation of $+.42$ in one instance and a slight negative correlation of $-.29$ in the second. Those disciplines with a high military potential, moreover, conform to the norm of internationalism with almost the same frequencies as those disciplines with a low military potential. It goes without saying that these results are contradictory to those obtained with reference to conformity to the norm of commonality.

SCIENCE AND SOCIETY

To those doctoral candidates, the primary role of science is the pursuit of knowledge. The scientist searches for the answers to questions derived from the theoretical paradigms of his discipline or specialization. This quest, in turn, transforms these paradigms and raises new questions that must be answered if knowledge is to be cultivated. The indirect by-products of this scientific role, however, are social roles and inputs to the other institutions of society. These future scientists maintain that these roles and inputs are secondary to the primary role of science and are established by society for science. Within this perspective, they perceive the interrelationship of science and society.

The Social Role of Science: Public Appreciation and Scientific Popularization. The doctoral candidates trichotomize the role of science in society into the following divisions: 1) technical, 2) social, 3) ideological. Sixty-five percent of the sample maintain that science performs a technical role in society. The ideological and social roles are perceived as consequences of the technical role. They attribute this dominance of the technological implications of science to the advanced development of the physical sciences and the ability of applied scientists to transform the solutions to problems of a theoretical nature to those of a practical nature. Secondly, the demands of the government, the economy, and the family for technological innovations in wartime and in peace enable the scientific role of science to be overshadowed by the technical role of science.

As a result, they hold that the general public in our society gives increased recognition to the scientist for the wrong reasons. Seventy-eight

percent of the respondents, regardless of discipline, give qualified affirmative responses when asked if they believe that the scientist is appreciated in our society. They maintain that the general public values the scientist in so far as he is able to contribute to further technological innovations. As long as the scientist continues to perform his technical role, our society will perpetuate its monetary and social rewards to the scientific community. If the scientist's technological usefulness ceases, this appreciation will also disappear. For when society views the scientist without his technological garb, he is seen as a strange creature with unusual interests and habits who lives in an ivory tower and belongs there. As one physicist stated, "it is a sterile hero worship. The public doesn't know what it admires." If the scientist attempts to perform any other role besides that which is allocated to him by society, he becomes a threatening figure who is to be watched and despised.

Even though this potential animosity towards the scientific community is perceived, the respondents believe that scientists should communicate the results of their experiments and new theoretical developments to the general public (see Table 7). Seventy-three percent give a non-qualified approval of popularization. Hence, the responses to popularization are negatively correlated, $Q = -.68$, to the responses made to the question on appreciation.. They perceive several types of communication: 1) direct popularization of science to the public by the scientific community; 2) direct popularization by writers who have been trained in science; and 3) indirect popularization through instruction of the youth in the normal course of education. Through these means, they believe that the general public might

keep abreast with scientific developments.

Table 7: Public Appreciation and Scientific Popularization

Public Appreciation	Scientific Popularization		
Responses:	Qualified	Non-qualified	Total
Qualified	15% (6)	63% (25)	78% (31)
Non-qualified	12% (5)	10% (4)	22% (9)
Total	<u>27% (11)</u>	<u>73% (29)</u>	<u>100% (40)</u>

$$Q = -.68; x^2 = 6.58, d.f. = 1, p .01$$

This belief is not shared by the remaining 27% who gave qualified approval. It is their contention that popularization will not lead to a diffusion of scientific knowledge because of several factors. Scientists will have to "water-down" the essential significance of any of their findings if they were to attempt communication to every segment of society. Secondly, the effort might be detrimental if it reinforced the stereotypic image of the scientist. And thirdly, some of the results of experiments could possibly produce mass hysteria or fear due to misinterpretations of the import of these findings. Therefore, this minority endorse limited popularization similar to what is occurring presently, a restricted audience to which such communication is directed, and the revelation of findings in a manner which will avert misinterpretation.

Science and the Institutions of Society. With the same tripartite division that segmentalized the role of science in society, the doctoral candidates outline technological, social, inputs of science to the other institutions of society. Each input is viewed as a product of the application of the results of pure research to practical problems and is defined as follows: a technical input is an innovation in some mechanical

apparatus used by an institution; a social input is an innovation in the structure and social processes of an institution; and an ideological input is an innovation in the normative order of an institution.

In each institution, they present their conceptions of the inputs of science. These institutions can be viewed as existing along a continuum constructed on the basis of these inputs. On one end of the continuum is the institution of religion whose scientific input is ideological. At the opposite end lies the economic institution (industry) which receives a technical input. The institutions in the intermediary ranges of the continuum (Government, Family, and Military in that order) receive a combination of inputs from science.

Table 8: Conception of the Inputs of Science to the Institutions of Society*

Conception of Input to Sci- ence:	Institutions				
	Religion	Government	Family	Military	Industry
Technical	---	64%	63%	87%	90%
Social	---	9%	18%	13%	3%
Ideological	73%	19%	5%	---	3%
No Response:	$\frac{27\%}{100\%}$	$\frac{8\%}{100\%}$	$\frac{14\%}{100\%}$	$\frac{---}{100\%}$	$\frac{4\%}{100\%}$
Total	(N=40)	(N=40)	(N=40)	(N=40)	(N=40)

* Percentage refers to the number of respondents, who mention the category as an input to the specific institution, over the number of respondents.

In each case, the doctoral candidates maintain that it is easier to identify the technical input due to its visibility and that the advanced state of the physical sciences is responsible for the tremendous impact of technology on the institutions of society. It is their belief, however, that the social science and the biological sciences will have a greater impact than before in the next fifty years and thusly produce new social

and ideological innovations. Two questions were asked to ascertain:

- 1) which science has had the greatest impact since World War II, and
- 2) which science will have the greatest impact in the next fifty years.

To the former, 99% of the respondents mention the physical sciences, 33% the biological, and 11% the social sciences. To the latter, however, 50% state the physical, 64% the biological, and 24% the social. (Percentages refer to the number of respondents, over the total number of respondents, that mentioned the specified division).

The Future of Society and Science. The sample of future scientists visualize the world and our society changing technically, socially, and ideologically in the year 2,00. Improvements in communication and transportation will make the world smaller, increase the interdependency of mankind, and dissolve national and ethnic boundaries. The average life span of the individual will increase because of the eradication of disease, improvements in the surgical techniques of medicine, and controlled environments. The standard of living will rise as new sources of food are developed, and as the birth rate declines through population control. As more jobs are created through technology and as the education level rises, the life-chances of the individual will expand. Finally many of the myths of mankind, religious, political, and cultural, will be destroyed and replaced by a rationalistic approach to life and the unknown.

But this optimism is cautious, for the danger of nuclear warfare is always present, the manipulation of the individual by governments can occur, and overpopulation may become a reality. These possibilities led one psychologist to paint this pessimistic portrait of the future:

There will be the following trends 1) the world will be either a barbarous wasteland, or 2) an overpopulated, highly organized society with

social manipulation of behavior, or 3) the ultimate destruction of the individual.

It also led several nuclear physicists to hope that future developments in their specialization, which might have application to nuclear warfare, will not occur. The belief of the enlightenment that "knowledge is power," then, is held only tentatively by these doctoral candidates.

The pessimists and the cautious optimists envision the performance of greater functions on the part of scientists in determining the future characteristics of the world. This estimate is based on their belief that the exponential growth of scientific knowledge and the scientific community will continue in the future, and that the interdependency of society and science will increase. The implications of this expectation is clearly shown in their predictions of future developments in science and the participation of scientists in the institutions of society.

As the scientific population increases, so will the demand for scientific personnel in the institutions of society. Seventy-three percent predict that the proportion of scientists will increase in industry, 65% in government, and 53% in the University. The majority believe that the functions performed by scientists will remain the same; only the number of scientists participating in these institutions will increase. In industry and government, however, several respondents foresee a change in the type of functions performed by trained scientists.

They predict an influx of scientists into the decision making levels of these institutions. In industry, scientists will preside over more managerial offices; in government, they will not participate as senators or as representatives, but as advisors in the upper levels of the various departments of the government formulating and executing the domestic and

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry, no matter how small, should be recorded to ensure the integrity of the financial data. This includes not only sales and purchases but also expenses and income. The second part of the document provides a detailed breakdown of the company's financial performance over the past year. It includes a comparison of actual results against budgeted figures, highlighting areas of strength and areas needing improvement. The third part of the document outlines the company's financial goals for the upcoming year, focusing on increasing revenue, reducing costs, and improving overall profitability. The final part of the document provides a summary of the key findings and recommendations, emphasizing the need for continued vigilance and attention to detail in all financial matters.

foreign policies of the nation. Only in the university will scientists continue to perform the same functions as they do now. They could not visualize any offices within the university that have not been held by scientists.

Using the present state of scientific knowledge as a baseline, the doctoral candidates predict scientific breakthroughs in all the branches of science. However, they find the assessment of future developments in any discipline a difficult task. The linear growth of science and the increasing interrelationship of specializations are obstacles in their predictions. Secondly, they feel at ease in predicting scientific breakthroughs in their discipline, or allied areas, but not in divisions outside their own.

Table 9: 2,000 A.D.: Changes in Scientific Personnel in Industry, Government, and the University

	Institution		
	Industry	Government	University
Change in Scientific Personnel:			
Yes	75%	65%	53%
No	22%	35%	42%
Don't Know	5%	---	5%
Total	$\frac{100\%}{(n=40)}$	$\frac{100\%}{(N=40)}$	$\frac{100\%}{(N=40)}$
Nature of Change:			
Increase in Proportion of Scientists	71%	54%	95%
Qualitative Change in Function	24%	39%	---
No Specification	5%	7%	5%
	$\frac{100\%}{(N=40)}$	$\frac{100\%}{(N=26)}$	$\frac{100\%}{(N=21)}$

As Table 10 reveals, respondents predict advances in their division of science with a higher frequency than in others. Although the clinical and experimental psychologists foresee breakthroughs in the other divisions of science with the same or higher frequency as their own division, they have the highest percentage of respondents predicting advances in the social sciences.

Aggregate results reveal that 73% of the sample visualize outstanding developments in the biological sciences. By the year 2,000, the genetic

Table 10: Disciplines and Predictions of Future Scientific Breakthroughs in the Physical, Biological and Social Sciences*

Division of Science Where Break- Through will Occur:	Discipline					Total
	Mathe- matics	Physics	Biology	Experi- mental Psychology	Clinical Psychology	
Physical	100%	72%	34%	50%	50%	58%
Biological	40%	45%	92%	33%	83%	73%
Social	----	18%	8%	50%	50%	23%

* Percentage refers to the number of respondents in the discipline, over the total number of respondents in the discipline, that predicted scientific breakthroughs in the specified division.

code will be fully understood and stereotype genetic systems will be developed. New surgical techniques and the use of artificial body parts will radically change the field of medicine. The causes of disease, such as cancer, multiple sclerosis, and cystic fibrosis, will be isolated and the road to the development of serums to combat them will be paved. Finally, despite their previous belief in the danger of overpopulation, new means of population control will be discovered to ease the birth rate as the morality

rate decreases.

Fifty-eight percent predict breakthroughs in the physical sciences. Advances in astrophysics will make interplanetary space exploration by machines and man a reality. Life on other planets will be discovered through such probes. Atomic physicists, in their search for the fundamental particles of the atom, will find a continuation between matter and energy. The growth of knowledge about Quasar and X-ray stars will enable physicists to develop some plausible explanation for the creation of the universe. In conjunction with psychologists and psychotherapists, the biochemists will produce drugs to combat mental disease.

In the social sciences, psychology will understand to a greater degree the functioning of the human mind and the dynamics of personality. Improvements in the theories and therapeutic methods will enable clinical psychologists and psychotherapists to locate the causes of mental disease and to treat formally incurable patients. In sociology and social psychology, scientists will understand the dynamics of group behavior, adopt mathematical techniques, and be able to predict in certain circumstances the behavior of individuals and groups.

Even though these advances of science will produce resultant changes in the nature of society, they do not portend the evolution of a new science. While maintaining a dynamic conception of society, the sample's view of the nature of science is static. Only 5% of these doctoral candidates contend that the basic characteristics of science will change. Nine out of ten construe the advances of science as additions to the ever-growing corpus of scientific knowledge. The breakthroughs imply improvements in scientific instrumentation and theories. Old theories may be reformulated

or new theories begun in light of these discoveries and advances; but science as a method, as a cognitive style, or as the study of the physical or natural world will remain immutable. It will not, as the minority suggest, become more subjective, less deductive, abandon the pursuit of knowledge, or take into account the spiritual. As one physicist stated, "Science either is what it was in the past and is today, or it does not exist."

SUMMARY: PROSPECTS FOR FUTURE RESEARCH
IN THE SOCIOLOGY OF SCIENCE

Several conclusions can be drawn from the results presented in the section on Conceptions of Science: 1) there is a considerable difference between the conceptions of the nature of science and of the membership criterion of the scientific community; 2) these conceptions vary with discipline; 3) the greater the emphasis placed by a discipline on defining science as a method, the greater the equivalence between the conceptions of science and of the membership criterion of the scientific community; and 4) self-identification as a scientist is determined by the conception of the membership criterion of the scientific community. If an individual views his discipline or specialization and his ability with the use of the scientific method as congruent with the criterion, he will positively identify as a scientist. If he does not, he will consider his position to be an aspiring scientist or negatively identify depending on the circumstances.

As has been shown previously, creativity is not the key element in the respondents' conceptions of science, perceptions of the membership criterion of the scientific community, or self-identification as scientists. In the first instance, the object of scientific inquiry is crucial; in the second and third, the

scientific method. Although these findings contradict Storer's theoretical assumption, they do not imply that the ability to produce novelty is not the scientific ideal toward which the normative order of science is oriented. Creativity may in fact be more important than the description of empirical reality or ability to use the scientific method at the professional level. No doubt it is a critical factor in vertical mobility within the scientific community. But to these doctoral candidates the acquisition of knowledge of the objects and methods of their inquiry is the necessary requisite for their participation in the scientific community. Whether or not creativity will become their scientific ideal once they move past their preprofessional status as graduate students can be determined by future research.

Since the international scientific community is a viable and visible entity in the eyes of the respondents, we have seen that the norm of internationalism is central to the respondents' conceptions of science. Even though they believe that the primary function of the international scientific community is the communication of information which implies conformity to the norm of commonality, they conform to the norm of internationalism more than to the norm of commonality. This implies not only that the norm of internationalism is more pervasive than the norm of commonality, but suggests that the concept of commonality may need reformulation and greater specification.

Rather than being a unified concept, there may be types of commonality or levels of conformity to the norm. For instance, there may be international commonality which demands common ownership of goods across social and political boundaries; national commonality which implies the sharing and scientific findings only within one nation-state; or disciplinary

commonality, the exchange of information amongst a limited group of scientists within one discipline. Or there may be conformity to the norm at the international, national, or disciplinary levels. Similarly levels of conformity to the norm of internationalism might be established.

We have seen that a minority of the respondents regard the international scientific community as composed of only the scientists involved in research on a specific problem, the elites of a discipline, or a specific discipline or area of specialization. Others visualize it as including all individuals who perform the role of a scientist. It may be possible to classify each of these as a level of conformity to the norm of internationalism with the last category as the highest level and the first as the lowest. Also a typology of international scientific communities possibly can be constructed on a similar basis. Through this method and the suggestions made with regard to the norm of commonality, conceptual clarification of both concepts might be attained.

In addition to these suggestions, the following conclusions can be made: 1) there is greater conformity to the norm of internationalism than to the norm of commonality; 2) military potential is a factor in conformity and non-conformity to the norm of commonality, but not in conformity and nonconformity to the norm of internationalism; and 3) disciplines with a high military potential have a greater tendency to juxtapose two contradictory normative behavior patterns than those with a low military potential. These results imply that the linkage of society and science has effected the behavior of these doctoral candidates to the normative structure of science. Whether or not the conclusions are applicable to a different group of doctoral candidates or disciplines, or a sample of scientists who have

professional status in the scientific community is an empirical question. Moreover, from a cross-cultural perspective one may ask the following: will the tendency towards nonconformity to the norm of commonality exist in those societies where the military potential of scientific research is not emphasized? Or will there be a greater deviation for the norm of internationalism in societies which are not center of science, for example, the developing nations? These are empirical questions that can be resolved only through future comparative and cross-cultural research.

Similar issues can be raised concerning the interrelationship of science and society. We have seen that: 1) the social roles and inputs of science to the other institutions of society are viewed as indirect by-products of the primary role of science, the pursuit of knowledge; 2) public appreciation is perceived as based on the technological usefulness of science and as temporary, yet a nonqualified belief in scientific popularization is upheld; 3) a continuum of institutions can be constructed on the basis of the conceptions of the inputs of science to the institutions of society; 4) society is viewed dynamically, changing in response to new scientific developments and the growth of the scientific community; and 5) the belief in the future of the world is either one of cautious optimism or pessimism. These projections point to an increasing interrelationship between society and science, a greater impact of science on society, and the extension of the exponential growth of science. But they do not indicate what effects these facts have on the structure of the institution of science.

Undoubtedly the respondents would maintain that science is unchanging in its basic nature. Yet as the section Commonality and Inter-

nationalism reveals, the applied social value of scientific research has led to a deviation from one element in the normative structure of science. What needs to be investigated, then, are the inputs of the institutions of society to the institution of science, and the effects of these systemic linkages on science. Moreover, the international scientific community must be taken into account in such an endeavor.

Since the international scientific community is composed of scientists from a variety of nation-states, the differences in the interrelationship of science and society within nation-states should also have an effect on its structure. Not only must the nature of these effects be investigated, but also the mechanisms through which the international scientific community reconciles differences in national scientific communities. In addition, the systemic linkages between the nations of the world and the international scientific community, and between the national and international scientific communities, must be located and analyzed. Through this means it may also be possible to outline the effects of the international scientific community upon societies and their institutions.

Before this can be attempted, however, it is necessary to specify the variations of interrelationships between society and science within the nation-states. We have seen that the doctoral candidates have given primacy to the technical role and input of science in society. Within the nation-states, it is possible that the social and ideological roles of science might be emphasized. If this were the case, the continuum of institutions would have to be rearranged to fit the societal setting.

For instance, in the case of the developing nations, the social role and input of science may be the main systemic linkage between science and the other institutions. Moreover, the input of society to science may be none existent in this situation and the national scientific community may receive its inputs from the international scientific community, international scientific organizations such as UNESCO, or from other nation-states. Similarly, in the case of the Communist nations, the ideological and social roles of science may be just as dominant as its technical role. Public appreciation, then, may hinge upon the contributions of the national scientific community to the maintenance of the ideological basis of the society and scientists may express a greater belief in scientific popularization.

In addition, through comparative research, one might seek to find out whether or not the belief in the unchanging nature of science and dynamic nature of society is universal amongst scientists. For instance, in the Soviet Union and Nazi Germany where the scientific community has experienced the fusion of the normative structure of science with the ideological framework of the society, would this belief exist? Only future comparative and cross-cultural research can resolve these issues.

NOTES

1. OSIRIS, IV (1938), pp. 360-732.
2. Social Theory and Social Structure, rev. ed., New York: The Free Press of Glencoe, 1957, pp. 537-549.
3. "Belief-System and the Social System: The Problem of the 'Role of Ideas'", "The Social System", New York: The Free Press of Glencoe, 1951, pp. 326-383.
4. Science and the Social Order, New York: The Free Press of Glencoe, 1952.
5. The Social System of Science, Chicago: Holt, Rinehart, and Winston, 1966.
6. A Methodological Footnote. Research and theory-building in the sociology of science and in general sociology will be facilitated if we can specify, however arbitrarily and tentatively, a general frame of reference for the study of institutions and total societies. At one level of analysis, the social structure of a society can be conceptualized as composed of more or less differentiated institutions--every society has the same analytical components of social structure, manifested in a variety of empirical institutions. Science is an institution--it is not universal, but is present in a range of cases which represent our universe of study. The sociology of science, as a substantive area, illuminates the nature of the relationships between science and the other institutions of the social structure, their effects on science in particular, and their effects on social structure in general (see page 2). The purpose of comparative and cross-cultural studies is to help us identify recurring processes, relationships, etc. The meaningfulness of this particular way of viewing one part of the social world is an empirical question--it is not a question of whether or not the world is "really like that;" but a question of whether or not the world is sufficiently like that.
7. Joseph Needham, Science and Civilization in China, London: Cambridge, 1954.
8. _____, Science and International Relations, Oxford: Blackwell Scientific Publications, 1949, p. 6.
9. Joseph Ben-David, "The Scientific Role: The Conditions of its Establishment in Europe," Minerva, 4 (Autumn, 1965).

10. Gavin de Beer, The Sciences were Never at War, New York: Thomas Nelson and Sons, 1960.
11. C. C. Gillispie, "Science and the French Revolution," Behavioral Science, 4 (January, 1959), p. 94.
12. Warren O. Hagstrom, The Scientific Community, New York: Basic Books, 1965, p. 9.
13. Storer, p. 58.
14. Ibid.
15. Unless otherwise specified, this quotation and the following are responses of the interviewees.
16. Robert K. Merton, "Science and Democratic Social Structure," Social Theory and Social Structure, p. 534.
17. Ibid.
18. U. S. Department of the Army, Scientists in Uniform in World War II, Washington, D. C.: U. S. Government Printing Office, 1948.
19. Barber, p. 229. C.f., U. S. President's Scientific Research Board, A Program for the Nation, Washington, D.C.: U. S. Government Printing Office, 1947.

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