VISITING FOREIGN SCIENTISTS AT AMERICAN UNIVERSITIES: A STUDY IN THE THIRD-CULTURE OF SCIENCE

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ABSTRACT

VISITING FOREIGN SCIENTISTS AT AMERICAN UNIVERSITIES: A STUDY IN THE THIRD-CULTURE OF SCIENCE

By

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The increase in the movement of people across conventional political and geographical boundaries during the twentieth century has stimulated, and been made possible by, the emergence of a world-wide system of transportation, communication, and exchange. Scientists have been disproportionately involved in this process of ecumenization. Their activities have created links among societies and led to the emergence of a "third-culture of science," cultural patterns created, shared and learned by scientists of different societies who are in the process of relating their societies or sections thereof to each other.

The significance of scientific activities as a link among societies in an increasingly interdependent world has been noted but not studied in depth. The present study focuses on visiting foreign scientists at American universities as one segment of the international system of scientific activities.

Data was collected from a non-random sample of 222 visiting foreign scientists at seven midwestern universities. Eighty-two interviews were supplemented with 140

usable returns on a mailed questionnaire. More than 90 percent of our respondents are physical or biological scientists, and most define their research as "basic." They are evenly distributed by home country origin between developed and developing countries. Their mean age is 32 years, and more than 75 percent are 35 years old or younger. Of the 180 respondents who have a Ph.D. or M.D., more than half have earned their degrees within the last five years.

The dissertation is organized around three basic themes: (1) conditions of work, (2) science as ideology, and (3) the modern (as opposed to traditional, or post-modern) orientation of visiting foreign scientists.

The conditions under which visiting foreign scientists work are conducive to social isolation and role intensity. Their involvement in basic research, their status as visitors, and a rigorous work schedule are among the factors which tend to isolate them from non-work milieu; their role repertoire is limited. Thus, our respondents are not active in social and political activities and organizations. The visitors' work experiences promote an orientation to science as an autonomous profession. Research efficiency and training in skills and techniques are stressed rather than innovation.

The concept of science as an ideology was suggested by the tendency of respondents to rationalize their feelings about science as an autonomous enterprise in terms of the norms of science, especially disinterestedness. Their definition of their research as "basic" explains and justifies what amounts to an obligation to eschew responsibility for the present and future social consequences of that research. But as the dysfunctions of professionalization and bureaucratization in science become more salient and converge, science becomes transformed into an ideology. This argument follows from the sociological view of science as a social process.

The visitors' modern orientation is discussed in the final chapter. Respondents are passively oriented to an international system of nation-states. They do not exhibit the active commitment to national and world development, and to the emergence of a world community characteristic of a post-modern orientation. It is noted, however, that their experiences in American universities _do_ stimulate a commitment to work and profession that transcends conventional commitments to neighborhood, community, and society; the marginal status this entails may be a precondition for arousing a post-modern orientation.

Finally, the dysfunctional impact of professionalization and bureaucratization on the third-culture of science is compared to biological processes which lead to a loss of diversity and decreased evolutionary potential. As scientists respond to problems of control and coordination in an interdependent world by simplifying, specializing, and standardizing, the evolutionary potential of human culture may be decreased.

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By

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PREFACE

Viewed in global perspective, the history of human culture is a history of increasing scale in human activity and human consciousness. The spread of transportation, communication, and exchange links around the world has, in modern times, created an empirical referent for the idea of a world society. The increasing movement of people, ideas, and materials across conventional social and cultural boundaries, and the growing challenge of global problems, such as population growth and environmental pollution, have established a global frame of reference which the concepts and perspectives of social science are ill-equipped to comprehend. This dissertation is based on problems associated with a global frame of reference in sociology.

I have selected for study one segment of the "international scientific community," visiting foreign scientists at several American universities. The role of the visiting foreign scientist in America is one of many science-related links between nation-states and cultures which many scholars consider to be important factors in large-scale social change. Such scholars consider international scientific activities in general to be critical in the development of modern nation-states, and to represent the prototype of an emerging world society. The widely-held assumption that scientific activities have a facilitative function in societal change reflects an intellectual investment in one or another version of the ill-fated "idea of progress." A reasoned assessment of the relations between science and society is difficult due to the lack of systematic and sustained empirical work in the sociology of science. Problems range from the lack of a sociologically-adequate conception of international scientific activities to beliefs about the inevitability of scientific progress and the emergence of a science-based world society. However such processes are defined, their dependence on certain theoretically-specifiable conditions should be recognized.

Scientific activities have been central to the development of human societies. The institutionalization of science beginning in sixteenth century Europe has made possible the conscious design of relationships between science and society, from Bacon's utopian _New Atlantis_ to modern technical assistance programs and the development of national science policies. Whether planned or the consequence of social forces we are unaware of, or do not understand and cannot control, scientific activities may obstruct as well as facilitate changes in social structure. Their effects, at any rate, are a matter for study and not to be taken for granted. Science is itself subject to change--it is a human endeavor influenced by social and cultural conditions. On another level, changes in science can be generated from within the social system of scientific activities.

Within this general perspective, I have selected for study certain aspects of the relations between international scientific activities, developmental processes on the national and world levels, and the spread of human activities around the earth. Empirically, this dissertation is based on interview and questionnaire data from a non-random sample of 222 visiting foreign scientists at seven midwest universities. The conceptual framework is much more broad. To begin with a conventional statement of problems, hypotheses, and methods would do an injustice to that framework and to the intellectual biography of my research. At no point in the research process have I lost sight of the impact of my readings in global history on my selection and formulation of a dissertation topic; nor have I felt that the limited and exploratory nature of my research should restrict me to a naive and insensitive dependence on my data. In beginning my dissertation with an introduction to global history and developing my empirical focus out of that introduction, I hope to convey to the reader some of the sense I have of its relationship to my data.

Sal P. Restivo

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More than any single individual, Professor John Useem has been responsible for making my graduate education an experience in intellectual growth. As major professor, chairman of my Master's and Doctoral committees, colleague, and friend, his advice has always been thoughtful, his direction unobtrusive, his ideas stimulating, and his encouragement consistent. It is impossible for me to adequately express my appreciation for the time and energy Professor Useem has devoted to my education as a sociologist.

Professor Ruth Hill Useem has had less to do with my day-to-day activities as a graduate student in sociology but has played a central role in my doctoral research program. I am grateful for her general criticisms, her attention to details, and her encouragement.

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Professor William H. Form was unable to serve in his capacity as one of the original members of my Doctoral committee. He did read two preliminary drafts of this dissertation, and I have followed many of his suggestions for revision. Through his kind words and actions, his honesty, and his often overwhelming expectations, Professor Form has contributed greatly to my graduate education.

Professor James B. McKee's conception of sociology as a humanistic discipline, his dedication to teaching as an intellectual enterprise, and his broad-ranging intellect have inspired my efforts as a teacher and researcher. His comments, suggestions, and critical questions regarding the ideas developed in my dissertation are most appreciated.

I regret that Professor Jay W. Artis was on leave during the period in which I completed my dissertation and therefore unable to be present at my oral examination. I have the highest regard for him as a person and a scholar, and have benefitted greatly from our too infrequent conversations.

In the absence of two of my original committee members, Professor Vincent Salvo was kind enough to accept on short notice an invitation to serve on my Doctoral committee. His acceptance and his comments on my dissertation are gratefully acknowledged.

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Science is no world-uniting power, and scientific communication is no sign of friendship and trust. It is such a sign only where the fundamental drive of science, which alone gives meaning to it, binds men existentially--where their common work makes them friends.

Karl Jaspers

CHAPTER I

INTRODUCTION

1. Perspectives and Problems

Raymond Aron (1961) has perceived in the twentieth century "the dawn of universal history." In this century, the increase in scale of human activity and human consciousness, i.e., the number of people in conscious relations (Honigman, 1959), has transcended the conventional boundaries, of socio-cultural[1] units such as tribes, nations, nation-states, culture areas, and civilizations.

Increase in scale at sub-global levels is not a new phenomenon in socio-cultural history; neither is the concept of an increase in scale which ultimately encompasses the globe in some type of world order. Within the boundaries of the ancient Middle East, for example, changes in scale occurred which broke down geographical and cultural barriers. William H. McNeill (1963: 127ff) uses the phrase "cosmopolitan civilization" to describe the "lively diplomatic, commercial, and cultural intercourse" that had developed by the fifteenth century B.C. in the area including Egypt and Mesopotamia.[2] In the history of ideas, it is possible to trace the linguistic roots of the "one world" concept to the Cynic word, "kosmopolis" and its behavioral roots to actual or dreamed of increases in socio-cultural scale.[3] Alexander conceived the goal of his conquests to be the establishment of "homonoia," i.e., human concord among the nations he conquered; the Stoic Zeno of Citium, a student of the Cynic Crates of Thebes, conceived of a world ruled by one divine and universal law; in China, the concept "ta t'ung" ("one world") originated in the pre-Confucian era and has survived into modern times (K'ang yu-Wei, 1958). In Islam, the universal society appears as "dar-al-Islam," the "abode of Islam."

A "World Order" is one of the central features in Western intellectual history. In Dante's De Monarchia, the idea is manifested in the "respublica Christiana"; it underlies Bacon's concept of global unification through "the thorough passage of the world . . . and the advancement of the sciences"; and it is part of the unified systems sketched by scholars such as Comenius, Hegel, Marx, and Comte.

The remarkable quality of the twentieth century is the "extraordinary change in scale of world events" described by Heilbroner (1963: 7): "It is as if the familiar newsreel of history had given way to a gigantic Cinerama, as if the once dark wings of the theatre were now illumined by an immense extension of the screen on which history is projected to us. And this sense of change in scale is not merely an illusion based on our receding distance from the past. During the middle years of the twentieth century we have actually been spectators at an unprecedented enlargement of human affairs, an enlargement which may well appear in the future as one of the great watersheds in human history."

Unlike our predecessors, we can root our ideas about a world society in the reality of world-wide systems of transportation, communication, and exchange. The vocabulary of the world-minded reflects the challenges inherent in trying to capture conceptually the emerging future; it stresses different foci and different visions: post-historical, post-modern, post-industrial, post-civilizational.

The visions of many contemporary prophets of world order continue to be informed by a Baconian Divine Providence. Aron (1961: 44-45), for example, refers to industrialization and the unification of mankind as "inevitable." A divine teleology inspires the emphasis Jaspers, and de Chardin place on the evolutionary continuity of the emergence of cross-cultural consciousness. Jaspers (1959: 340) writes, the "intercourse between peoples has meant a continual growing together of mankind, the creation of unity through the planet's becoming one to the consciousness, and ultimately to actions of men." A comparable sense of "inevitability" is articulated in de Chardin's writings on "complexification" and the emergence of the noosphere (1959, 1960, 1964).

For some scholars, however, the future is not so certain. Juxtaposed to the vision of one world is "a haunting fear of there being no world for man" (Useem, 1963: 481). Toynbee (1946: 207) asks, "Is the new social driving power of industrialism and democracy to be employed in the great constructive task of organizing a Westernized world into an ecumenical society, or are we going to turn our new power to our own destruction?"

Among the most systematic perspectives on the problematics of a world society is that of Harrison Brown. On the basis of an analysis of global ecology, the distribution of natural resources, and the potentials for exploitation and utilization of human and non-human resources, Brown (1954: 264ff) suggests that, of the alternative futures available to mankind, the most likely to be realized is "a reversion to agrarian existence": "This is the pattern which will almost certainly emerge unless man is able to abolish war, unless he is able to make the transition involving the utilization of new energy sources, and unless he is able to stabilize populations." A "completely controlled, collectivized industrialized society" is the next most likely possibility. Least likely is the emergence of a world-wide free industrial society."

Elsewhere, Brown's alternative worlds are personified in the conflict between Seidenberg's Post-historic Man--the bureaucrat/technocrat--and Mumford's One-world Man, who "will gladly sacrifice his mechanical efficiency, along with his cocksureness and complacency, in order to enhance the quality of life itself" (Mumford, 1956: 180).

There is, across the variety of futures imagined, a pervasive Western bias. I have already quoted Toynbee on "organizing a Westernized world into an ecumenical society." The "great theme" of Peter Drucker's post-modern world (1959: 246f) emerges with "the disappearnace of the East and its Westernization": "The emergence of a common, basically Western world civilization is the greatest of our new frontiers--the greatest change and the greatest opportunity." McNeill (1963: 878) captures in prose the "dramatic spectacle" of an emerging Ecumene. His history concludes with the contemporary emergence of a "world-wide cosmopolitanism" growing out of the Old World Ecumene. "'The Rise of the West,'" he urges, "may serve as a shorthand description of the upshot of the history of the human community to date . . . no matter how it comes, the cosmopolitanism of the future will surely bear a Western imprint. At least in its initial stages, any world state will be an empire of the West." In 1917, according to McNeill's schema of history (1963: 867), a new phase in world history began, "marked by the Communist transformation of Russia, the rise of the United States to world power, the eclipse of western Europe as undisputed center and arbiter of Western Civilization, and by enormous advances in man's ability to manipulate human as well as inanimate energies." Kenneth Boulding (1969: 347) locates a new phase in the emergence of a modern world civilization earlier in time than McNeill but within the Western sphere; with the discoveries and conquests of the Spanish and Portuguese in the West, and East to the Philippines and Japan, man reached "the moment of globalization, the moment in human history at which the earth ceased to be a great plain and became a sphere."

In their attempts to comprehend the emerging future, men have created stimulating and imaginative prospects. Their mental futures, however, have often been grounded in a metaphysics of inevitability and a provincial Western experience. There is no completely adequate framework in social science for dealing with changes in scale in human activity and consciousness within a global setting. There is a promise for such a framework in the ideas of Alfred Kroeber, and Gordon Hewes concerning "ecumene," and it is to their work I now turn my attention.

The Ecumene: A Sociology of Global History

The increase in scale of socio-cultural phenomena to global levels has accentuated the necessity noted by Julian Steward (1955: 44) for "an adequate conceptualization of the phenomenon of socio-cultural systems above the tribal level." Steward argues that "in the growth continuum of any culture, there is a succession of organizational types which are not only increasingly complex but which represent new emergent forms." Hewes, proceeding from Kroeber's paper on "the ancient oikoumene" (1946), places "the Ecumene" in Steward's "succession of organizational types or levels of socio-cultural evolution." An Ecumene, or Ecumenical System, is defined by Hewes (1965: 74-75) as:

> . . . a set of functionally interconnected civilizations, linked by actual roads, sea-routes, and other channels of transport and communication, over which move agents of commerce, diplomacy and warfare, and religion, such that constituent civilizations tend toward a common and advancing technological base, come to share various styles, scientific, philosophical, and religious ideas, political forms, and so on. Such a system also tends to expand geographically, incorporating new areas and peoples through trade, conquest, colonization, missionary effort, and the attraction which ecumenical affiliations may have for the leaders of marginal or external societies. The same long-distance transport and communication facilities required to maintain the internal linkages of the ecumenical system place its societies in a favorable position to employ them in this process of incorporating distant outside areas.

Such an ecumenical system, Hewes notes, eventually "envelops the planet."

The process of "ecumenization" is imagined to begin in an historical period characterized by the isolation of "nuclear" civilizations:

> . . . when intercommunication between these nuclei and secondary civilized centers reached a certain level of effectiveness, the Ecumene emerged. A very rough analogy makes this sharper. The earlier phases--Copper and Bronze Age phases--of civilized growth may be likened to a three-ring circus, with essentially unrelated performances under way in each ring. As the affair progresses, things become more complicated, more rings are opened up, and the entire company gradually comes to engage in an immensely intricate dramatic spectacle.

Hewes sees the emergence in this century of an ecumenical system, "socio-cultural" in nature and "marked by a rising awareness of the whole on the part of its members." Such a system, Hewes cautions, does not entail a Pax Ecumenica: "a fairly high degree of cultural similarity can exist without political unification . . .," as in Latin America, or Western Europe.

In theory, according to Hewes, "two or more ecumenical systems might have emerged "on the earth, but as it happened, there has been only one. This is partly a function of the different configurations of the land masses in the Old and New Worlds."

Hewes' conceptualization defines the process of ecumenization as the unilinear development and diffusion of

Western culture. His perspective carries with it a clear intimation of inevitability. Nonetheless, his analysis can be applied, with modifications, to a study of increase in scale at the socio-cultural level. The earth can be considered a geo-physical, bio-spherical environment upon which socio-cultural history has unfolded. A global ecumene of sorts is now in existence as a consequence of the development of links between, among, and across subsystems on the same order as those Hewes describes within the Old World Ecumene: "local primary communities," "local or regional socio-political units," and "civilizations." In addition to the Old World Ecumene, it is possible to identify two other major ecumenical systems--one in the Chinese culture-area, and another on the Indian subcontinent. Other minor ecumenical systems might be usefully identified, e.g., in the Middle East and in Africa. In these terms, the global ecumene is conceived to emerge out of the development of links between and among the major and minor ecumenical systems. The process of ecumenization, whether the frame of reference is the Old World, China, or the globe, depends on the movement of persons engaged in what Hewes refers to as "prosaic activities": "foreign trade, diplomacy, transport and communication, missionary effort, book translation, and in modern times, the work of scientists, scholars, journalists, and even tourists" (Hewes, 1965: 81).

The emergence of the modern world Ecumene has been accompanied by, and in some cases made possible by "an enormous increase in the speed, frequency, and in volume of transport and communication" (Hewes, 1965: 102). This increase, in conjunction with "prosaic activities," has made it necessary for social scientists to develop concepts for describing and interpreting the emergence and development of collectivities possessing some form of "cultural" boundary but not the usual political or geographical boundaries. Such collectivities have been analyzed in the work of Professors John and Ruth Hill Useem on "third-culture."[4]

The Third-Culture

The Useems use the term "third-culture" to refer to the cultural patterns "created, shared, and learned by men of different societies who are in process of relating their societies or sections thereof to each other." There has been an expansion of the linkages "both conflicting and cooperative, among the societies of the world," promoting "an increasingly interdependent world." The Useems (1967: 130) have drawn attention to "the men-in-the middle who transform the broad aims of joint societal endeavors into going enterprises, who implement policy decisions through personal confrontations in the day-to-day performance of their work roles, who innovate the accommodations and adaptations necessary to interconnect two or more bureaucratic structures."

Within the context of "growing interdependency," the Useems focus on modernizing roles in the third-culture (1968: 143):

> Part of the enlarged scale of interdependency between the newly-developing and the more developed countries, a predominant characteristic of our times, are the systems designed to facilitate the process of modernization: programs to advance educational exchange, institution building, technical and economic assistance, business and industrial innovations, expansion of the scientific community, application of technology, and the strengthening of development organizations.

The Useems anticipate a growing concern in the developing nations with creating viable national "scientific communities"; on a larger scale, they discern "the evolving of world-wide scientific groups which include segments of scientific communities from many different societies" (Useem and Useem, n.d.: 1). The application of the third-culture concept to science has led the Useems to studies of the "expansion of the scientific community" as a system "designed to facilitate the process of modernization."[5] This study is part of the broader investigations presently being directed by the Useems.

It should be evident that the conception of science as a third-culture is closely allied to the idea of an "international scientific community." The distinctions among these and related concepts, e.g., the social network of science, are discussed in my final chapter. In this introduction I wish to critically review some of the empirical bases for "international scientific community" and "third-culture of science."

The International Scientific Community

The "international scientific community" has been characterized as the most important trans-societal system in ecumenization: it has been defined as the basis for, or microcosm of an emerging world community; it is conceived to be critical in unifying national programs for controlled manipulation of the global environment; and it is viewed by some scholars as crucial to processes of development and modernization (see esp. Apter, 1965).

These ideas involve implicit and explicit definitions of the relationships between science and society. Such definitions can be classified according to their basis in (1) intuitive and metaphysical assumptions, and (2) empirically-grounded ideas and theories.

The metaphysics of science and society has its modern roots in Francis Bacon's interpretation of the prophecy of Daniel--"many shall run to and fro, and knowledge shall be increased"; Bacon saw in this statement the fated destiny, by Divine Providence, of scientific advance and "the thorough passage of the world" meeting "in the same age." Bacon's intellectual heirs today proclaim science as an essential factor in world integration, a "savior of mankind," and the primary basis for a "true world culture" (Wagar, 1963: 154, 174). Recently, the Nobel laureate Sir Peter Medawar (in Greenberg, 1969: 1239) expressed the belief, sanctified by reference to Bacon, that "The deterioration of the environment produced by technology is a technological problem for which technology has found, is finding, and will continue to find solutions." Such uncritical expressions of faith betray an ignorance of the relationship between values and, more broadly, other non-technological cultural factors and manifest an optimism that draws its sustenance from the "idea of progress."

In one sense, and paradoxically, Bacon also anticipated critical conceptions of the relationship between science and society. Merton (1957: 607), for example, reiterates Bacon's intimation, but without any reference to inevitability or fate when he notes that "the interplay between socio-economic and scientific development is scarcely problematical." In this context, scientists are defined as significant actors in various aspects of ecumenization. In economic terms, scientists are defined as "strategic human capital" (Harbison and Myers, 1964);[6] in political terms, they are "elites" (Apter, 1965); in social psychological perspective, the value-orientations of scientists are perceived to be a basis for global cooperation and the development of a world community (Apter, 1965: 436).

The growing awareness of the ecological unity of the earth among both scholars and laymen, most imaginatively and comprehensively expressed in the works of Fuller (e.g., 1963) is the source of changing conceptions about the functions of international scientific cooperation. Roger Revelle (1963: 138), for example, writes: "It is by no means clear how scientific cooperation on a worldwide basis can best be used to attack [the] appalling questions of our time. But it is obvious that their solutions will be found only if science and technology are brought to bear in the broadest possible way and with urgent intensity." The critical relationship between science, technology, and societal problems is noted elsewhere, and in more quantitative terms, in such works as Brown's <u>The Challenge of Man's Future</u>, and Richard Meier's <u>Science and Economic Development</u>; it is manifest in the proliferation of international conferences on science and the new nations, e.g., the UNESCO conferences on science and technology (UNESCO, 1963 and 1970), and the 1960 conference on Science and The Advancement of New States held in Rehovoth, Israel (Gruber, 1961; see also Shah, 1967 and Shils, 1967).[7]

That science and scientists are strategic components of large-scale social change is hardly problematic. There are, however, serious gaps in our knowledge concerning science, scientists, and contemporary societal changes. Among the most critical questions confronting the sociologist of science interested in contributing to such knowledge is, what is the nature of the scientific community.

Philosophers, theologians, scientists, politicians, intellectuals, laymen, and specialists in the sociology and history of science, irrespective of differences in perspective and ideology, have used the term "scientific community" to refer to what in sociological terms would be a homogeneous social group, or collectivity.[8] Edward Shils (1958: 15), for example, writes that the scientific community "approximates most closely to the ideal of a body bound together by a universal devotion to a common set of standards derived from a common tradition and acknowledged by all who have passed through the discipline of scientific training." This idea, however, has been more often asserted or assumed than subjected to systematic study.

The Third-Culture of Science

The physical mobility of persons engaged in scientific activities has been a notewrothy aspect of the history of science. It appears, for example, that large numbers of outstanding Greek scholars in the late pre-Christian era migrated (Dedijer, 1968: 13-14). Until about 300 B.C., the main flow of this migration was to Plato's Academy and Aristotle's Lyceum in Athens. As a consequence of the efforts of Ptolemy Lagi (323-285 B.C.) and his son, Ptolemy Philadelphus (285-247 B.C.), Alexandria succeeded Athens as a scientific center; among the scholars who lived and worked in third-century Alexandria were Zeno the Stoic, Epicurus, Euclid, Eratosthenes, Archimedes, and Aristarchus of Samos (Albright, 1957: 339f). But Sarton has noted (1959: 9-10) the greater movement of superstitions as opposed to scientific ideas. Neither was there a great movement of scientific ideas to the East; in proportion to the Asiatci population, "the Greek emigrants were too few in pre-Christian times and too little interested in science and scholarship to affect and change Eastern minds. . . ." (Sarton, 1959: 11). There was no continuous diffusion of science, and men who possessed scientific ideas were by no means mobile in great numbers.

Nevertheless, centers for scientific activity which attracted scholars from widely separate areas emerged and flourished in East and West prior to the beginnings of the scientific revolution in sixteenth century Europe. By the fourth century A.D., Rome had become the center of so great a flow of students from Gaul and other provinces that special decrees were issued to govern their conduct (Haarhof, 1920: 241). The most famous of the early academies in China was the Academy of the Gate of Chhi, founded in the fourth century B.C. (Needham, 1969: 243). In Nalanda, India, a Buddhist school attracted Asiatic pilgrims between the fifth and twelfth centures A.D. (Moskerji, 1947: 563-564; Altekar, 1948: 123, 125); a center for higher learning was organized at Gundi Sapur in East Persia early in the sixth century A.D. (Dedijer, 1968: 17); and in 639 A.D., the emperor T'ai Tsung established a center in China which attracted "barbarian" students (Galt, 1951: 328; see also Martin, 1901: 378). Baghdad and Azerbaiijan were also important science centers in the centuries preceding the Middle Ages (Needham, 1949). Not only centers, but also individuals attracted scholars, Abelard being an outstanding example (Dedijer, 1968: 20).

From the thirteenth to the fifteenth century, the vanguard of the West's scientific revolution was visible in the "migration of intellectuals across political boundaries" to the universities of Europe. At Bologna and Paris, "the foreigners seem to have constituted the majority of the student body" (Dedijer, 1968: 21).

With the emergence of modern science in Western Europe from 1500 on, an increase in the scale of "international science" and in the degree of institutionalization of scientific activities occurred. During the twentieth century, scientists have participated in a social system developed over a period of four hundred years; the growth of this system has made it possible for scientists to participate disproportionately in the increased movement of persons across cultures (Shils, 1960; Thomas, 1967 and 1968).

The generation of scientists trained during the post-World War II decades has experienced two forms of cross-cultural mobility on a larger scale than any prior generation of scientists: (1) geographical mobility--scientists have been <u>active</u> participants in cross-cultural relations as visitors and advisors in foreign countries, and <u>passive</u> participants as nationals "hosting" visiting from other countries, and (2) psychic mobility--they have been senders and receivers in a growing and increasingly global system of scientific activities. The increase in scale of scientific activities during the last quarter century is manifested in the facts of (1) exchange of scholar programs, (2) institution-building and other forms of technical assistance programs in the new states, especially for higher education, (3) "brain drains," (4) the frequency of international conferences, (5) the number of individuals participating in such conferences, (6) the emergence of international scientific organizations, including federations of national scientific organizations, (7) "international laboratories," where scientists from different nations work together, e.g., the medical laboratories at the Harvard Medical School, and (8) the organization of international scientific "cooperatives"; on the regional level, for example, these include (a) the European Atomic Energy Community (EURATOM), which maintains joint research centers at Ispra (Italy), Geel (Belgium), Petten (Holland), and Karlsruhe (Germany), (b) the European Organization for Nuclear Research (CERN) in Geneva, (c) the European Space Research Organization (ESRO), which maintains several centers, the largest (the European Space Technology Center--ESTEC) located in Noordwijk, Holland, and (d) the International Rice Research Institute (IRRI) in the Philippines; on the global level, activities such as the International Geophysical Year are illustrative. These aspects of scientific activity are among the basic empirical referents for conceptions such as "international scientific community," and "third-culture of science."

The conceptual focus of my research is the third-culture of science. In contrast to "international scientific community," the third-culture concept emphasizes science and the scientific role as links among nation-states and cultures; it underlines the relation between scientific activities and large-scale processes of social change, e.g., economic development, modernization, and the increasingly international and trans-societal scale of human activities.

Following the Useems, the working definition of "third-culture of science" is "the cultural (including intra-scientific) patterns created, shared, and learned by scientists of different societies who are in process of relating their societies or sections thereof to each other"; the scientific role thus implied is a "modernizing role" that "might provide a model of relatedness, and supply the perspective necessary for participation in the ecumene . . ." (Winter, 1968: 4).

The conception of science as a third-culture requires that we consider variations in the types of societies the third-culture links. The facilitation and/or obstruction of the modernizing processes the Useems associated with third-cultural activities depends on the degree to which the goals of nation-states at different levels of development and linked by third-cultures are, or are becoming, interrelated and interdependent; third-cultural patterns "hold forth the promise of greater unity among people from different societies" (Useem, 1963: 11). Where men from different societies interact on a more or less regular basis, there must be shared norms, values, beliefs. The question is what norms, values, and beliefs are shared in the third-culture of science. To what extent is the "shared-ness affected by the home country origins of the interacting scientists? These questions led us to incorporate a method for identifying the "level of development" of our respondents' home countries.

Having established a conceptual foundation at the most general level, it is now appropriate to relate my concerns about the third-culture of science to problems in the sociology of science. The problems selected are critical ones in the sociology of science, and therefore demand attention in any study of science and society. They are the basis for delineating the nature and delimiting the scope of my research.

2. Problems in the Sociology of Science, Working Hypotheses, and General Plan of the Dissertation

Conditions of Work

The conception of science as a "monolithic entity" dominates the entire range of literature in the sociology of science and related fields (Kaplan, 1964: 854; Rose and Rose, 1970: 263). Numerous sources of heterogeneity within the scientific community have, however, been suggested. Most of these suggestions involve differentiating scientific activities on the basis of "subject matter" into physical, biological, and social sciences.[9] The criteria for differentiation include (1) length of the theoretical chain linking general principles with common sense language and experience, or the extent to which mathematics is an important element in the theoretical structure,[10] (2) cost and scale of research (Coser, 1965: 299), (3) degree to which theory and methodology are susceptible to social and political influences (Hirsch, 1961), (4) degree to which theory and methodology are "well-organized" (Menzel, 1958; Price, 1965: 107; Storer, 1967), (5) degree to which norms are specified for a concrete set of practices (Hagstrom, 1965: 11), (6) degree to which paradigms organize theory and methodology (Kuhn, 1962, and 1963: 344), (7) nature of methodology (including technique),[11] (8) level of development of scientific community and sectors thereof, and associated systems of prestige-status-esteem relative to other institutions, organizations, and roles,[12] (9) variations in occupational role behavior (Becker and Carper, 1956: 288-300), (10) differences in "intellectual or cognitive styles of performance" (Spencer, 1966: 296). These criteria are related to the organization of work in science. If we turn from the suggestive and speculative to an examination of the more coherent literature in the sociology of work, occupations, and professions, the rationale for hypothesizing sources of heterogeneity in science is considerably strengthened. This literature reinforces the significance of observed and suggested differences in (1) occupational role behavior, and (2) "intellectual or cognitive styles of performance" among scientists.

The relationship between variations in conditions of work and variations in the conceptual and activity patterns characteristic of occupational and professional collectivities has been extensively documented.[13] There is, however, no general theory that logically relates specific conditions of work to specific cognitive and activity patterns in individuals, groups, and collectivities.

It is sociologically naive to suppose that significant variations within the scientific community will neatly differentiate physical, biological, and social scientists. It seems more reasonable to assume that specific work conditions are systematically related to specific cognitive and activity patterns. There may, of course, be significant overlap of these conditions so that a particular configuration is associated with a given occupation or profession; but the appropriate independent attributes are work conditions and not broad occupational or professional categories.[14]

To the extent that the system of scientific activities or any sector thereof is characterized by heterogeneity of work conditions, the ideas and activities of scientists will vary; to the extent that work conditions are homogeneous (which would not be the case for the total system, but likely for sectors thereof), it is reasonable to expect homogeneity in the ideas and activities of scientists.

The <u>working hypothesis</u> that follows from the above discussion is: to the extent that the conditions of their work

working condition (independent V.)
ideas, activities (dep. V.)

are similar (homogeneous), the ideas and activities of scientists will be similar (homogeneous). In Chapter 2, I sketch the logical relationships (hypothetical) between specific conditions of work and specific ideas and activities. This tentative schema is based on, but not entirely dependent on, the descriptive analysis of the conditions of scientific work among the visiting foreign scientists in my sample. The reason for this approach to the problem is clarified in the section on methodology.

Norms

There has been a general tendency in the sociology of science to abstract generalizations and "theories" from idealized conceptions of science and scientists rather than from empirical studies of scientific activity. This tendency is most evident in the attempts by sociologists to abstract the "norms of science" (Parsons, 1951: 343; Merton, 1957: 550-561; Barber, 1952: chapter 4; Storer, 1966: 76-86). These attempts have proceeded from an idealized conception of science to the abstraction of "norms" and then to the assumption that the abstracted norms directed the activities of working scientists. But the relationship between the "norms of science" and the actual ideas and activities of scientists has not been systematically explored. Storer has noted the difficulty of operationalizing the norms,[15] but this is only one aspect of the general problem--what is the relationship between the norms of science abstracted by sociologists of science, and the ideal and actual cognitive and activity patterns among scientists?

A study of the norms of science was not an important part of the original research plan. Questions on the norms were constructed with the objective of exploring problems in operationalization. Interviewee responses to questions on "disinterestedness," however, suggested an idea that had not been considered prior to beginning the field work: the norms of science have an ideological function. In conjunction with ideas developed in studying the visiting foreign scientists' work milieu, it now occurred to me that the ideologicalization of science was not an unexpected consequence of professionalization and bureaucratization in science. Therefore, a chapter is devoted to the idea that American scientific activities have an ideological component that reinforces the scientific ideology of visiting foreign scientists and affects (1) the nature of their professional training, (2) their role as a link between nation-states, and (3) their roles as agents of social change.

Boundaries

The precise definition of the boundaries of science as a social system falls outside the scope of this dissertation.

I have followed customary usage among sociologists of science in defining "scientist." The problem of defining "scientific community" is more difficult. There are unresolved problems with the two concepts already introduced in outlining the frame of reference for my research, "international scientific community," and "third-culture of science." "Community" and "culture" are both part of the basic vocabulary of sociology; yet, neither customary usage nor fiat has established a generally accepted definition for community or culture. It may be true that, as Haberer (1969: 7) notes, we know the "international scientific community" exists; "what we do not know so well is the kind of community with which we are dealing and the sense in which it is a community." It is important that we examine the empirical content and analytic significance of "community," as well as "culture," and "international," with reference to scientific activities. In my final chapter, I discuss the modern orientation of our respondents (as opposed to a post-modern or traditional orientation) and I explore the relevance of the vocabulary of social networks for comprehending the complexity of world-wide scientific activities.

3. Design and Methods

In its original conception, this study was designed to focus on conditions of scientific work (independent attributes) and conceptual and activity patterns of scientists in third-cultural roles (dependent attributes; on our use of the term "attributes" see Lazarsfeld and Barton, 1951: 169ff). It was my intention to explore the relationship between a set of conditions of work, or dimensions thereof, and selected dependent attributes, to weigh the relative influence of the conditions of work, and to explicate the relationships between independent and dependent attributes. I assumed my data would exhibit correlational patterns; I was not certain what these patterns would be. My intention was to confront the theoretical problem of relating conditions of work to patterns of ideas and activities. What follows is a discussion of my original sampling design and general methodology, and the nature of the final sample. The plan of the thesis outlined above is based on the changes in focus pressed upon me in the field.

The Universe and the Sample

The conceptual universe was defined to include all social settings in which scientists from two or more societies are involved for some measurable and durable interval of time in scientific activities requiring their regular and cooperative interaction. Such settings are defined as third-cultural settings, and the scientists involved in such settings are by definition third-cultural actors.

Third-cultural settings must be defined at societal and organizational levels. Based on available resources and the nature of our research objectives, the United States was defined as the societal setting; in particular, the locus of third-cultural settings in science was defined to be within the boundaries of six midwestern states: Michigan, Ohio, Indiana, Illinois, Wisconsin, and Minnesota. Universities in these states were defined as third-cultural organizational settings if they were host to visiting foreign scientists. Given the survey data available, the most visible and readily discernible third-cultural scientists are visiting foreign scientists; they are links between at least two societies, and lists of visiting foreign scientists are available (though less reliable than anticipated in designing this study).

The empirical universe was defined to include all visiting foreign scientists in residence at a selected number of midwest universities during the 1969-1970 academic year. This definition was later expanded to include the 1970 summer session. Visiting foreign scientists are active participants in the third-culture of science by virtue of their cross-cultural experience and their "alien" status in American society. They are also, in general, members of the younger generation of scientists. They have been professionally socialized in an international milieu, and their conceptual and activity patterns should afford some measure of (1) the effects of the increase in scale of scientific and societal activities, and (2) their potential for facilitating and/or obstructing large-scale social change.

The definition of "visiting foreign scientist" follows the definition of "visiting foreign scholar" used by the Institute of International Education: All foreign citizens not considered students (e.g., visiting professors, lecturers, instructors, advanced research and teaching fellows and associates, visiting scholars, academic guests, specialists and all such foreign senior participants in educational programs) who are physical, biological, or social scientists; who will be in residence at a university meeting our criteria for inclusion in this study as a research site; who will be on campus for one month or longer during the 1969-1970 academic year (and including the 1970 summer session); and who have their permanent residence in a foreign country.

The classification of scientific fields according to the categories "physical," "biological," and "social," follows the system used by the National Science Foundation in their classification of scientific occupations.[16]

Universities were selected as research sites if they had hosted 100 or more visiting foreign <u>scholars</u> (data for <u>scientists</u> were not available) each year for the past few years, i.e., those universities which were likely to have 100 or more visiting foreign scholars during the 1969-1970 academic year.

The significance of using data for scholars, and the limitations imposed by restricting our sampling to midwest universities can be evaluated in part by noting that (1) nearly three-quarters of the visiting foreign scholars in a given year are in the physical and life sciences, medical sciences, social sciences, and engineering, and (2) approximately one-third of these scholars in any given year over the past few years have been in residence at midwest universities and colleges (Institute of International Education, 1965 to 1970).

Techniques, and Selection of Research Sites

The exploratory objectives of our research, and the fact that individuals for whom English is a second language might have some difficulty with certain concepts, questions, or "scales" prompted our decision to use personal interviews as the primary initial source of data. We also expected our respondents to express a critical, oftentimes skeptical interest in social science research. Establishing rapport in the interview situation had to be integrated with legitimizing our research so that respondents would take our work seriously; this was facilitated by the personal interviews. In the field, two factors appeared to contribute much to legitimizing our "scientific roles"; one was the fact that our research was being financially supported by the National Science Foundation, and the second was our ability to intelligently discuss or ask questions about problems and issues in physical and biological science.

Our interview schedule was constructed, pre-tested on American and visiting foreign scientists,[17] and the final schedule (not counting modifications in the field) organized and mimeographed. The final schedule included some pre-coded items, but most of the questions were open-ended. Most yes-no items were followed by probes. The schedule required approximately one and one-half hours to administer.

Mr. C. K. Vanderpool and I conducted the interviews.[18] We worked separately in the field. Certain standardizing procedures were necessary to insure data comparability. These procedures were developed and tested in any earlier collaborative study (Restivo, 1966; Vanderpool, 1966). During the pre-test period we interviewed respondents together, independently, and with our colleague present as a non-participant observer. Comparison of interview results, and the study of tape-recorded interview sessions aided in sensitizing us to our own and our colleague's style. Devices such as underscoring words to be accented in reading questions from the schedules, and written specification of probes were used. Tests of the comparability of our interview techniques and styles, our use of probes, and data-comparability during the pre-test periods for this and the earlier study established our confidence in these procedures.

Interview Sites

Three major universities with established graduate and professional schools were selected as interview sites. These universities were characterized by (1) some disparity in "quality rating" based on an index derived from ratings in the Carter (1966) report, (2) some diversity in community setting, and (3) accessibility, determined by time and travel funds available for the project. In each case, a high administrative officer of the university was informed of our intention to undertake research on campus. This procedure established our identity on the campuses; our study was not in any way sanctioned by these administrators, though they did extend us several courtesies, including assistance in setting up on-campus offices. Each of the selected universities is a major center for third-cultural activities.

Sampling Procedures and Design Modifications

Our original sampling frame consisted of a list of all visiting foreign scientists in residence at the three interview sites for the 1969-1970 academic year.[19]

The sampling frame was stratified along two dimensions; type of discipline (physical, biological, and social), and level of development of visitor's home country (developed, and developing). The latter dimension is discussed below.

A random sample of fifty elements was drawn from each cell of the stratified sampling frame for an N of 300. The size of the sample was determined by considering (1) the number of elements in each cell which would allow for necessary sub-classifications in the analysis without yielding empty cells or cells with too few elements, and (2) the number of interviews two interviewers could reasonably expect to complete over the planned duration of the field phase.

This design could not be implemented due to flaws in the primary survey data. Once in the field, we discovered that numerous individuals in our sampling frame were not, in fact, in residence at the interview sites. Many of the individuals listed in the primary survey had terminated residence, some as much as two and three years before. The problem was especially acute among social scientists. Nationally, fewer than ten percent of visiting foreign scientists in the United States for 1969-1970 were social scientists. Only twelve social scientists appeared in our final sample.

The failure of our original design forced us to abandon random sampling and the systematic exploration of relationships between independent and dependent attributes using standard statistical analyses. We simply attempted to reach every physical, biological, and social scientists in residence at the research sites. Our target N for interviews was lowered considerably; the time required to administer the interviews plus other time/cost factors brought our target N down to 100. We completed eighty-two usable interviews. This phase of our research began in March and ended in August 1970.

Mr. Vanderpool and I arranged each of our interviews by telephone. Only three potential respondents refused to participate in the study; Mr. Vanderpool encountered one refusal, and I encountered two, one due to an extremely poor command of English by a potential interviewee.

Most of the interviews were conducted in an office set aside for us at the research sites. Some interviews were conducted in our respondents' own offices or their laboratories. While the interview schedule was strictly adhered to, the "atmosphere" was generally informal and the dialogue often conversational. The interview situation was relatively stable from interview to interview. Our respondents were extremely cooperative. In my Master's research, I discovered that initiating a discussion of my respondent's field of interest, or of scientific method, aided in establishing rapport. This "technique" was used in this study with similar results.

As Mr. Vanderpool and I neared the completion of approximately fifty interviews (about twenty-five each) we began to be noticeably affected in our interview styles by the emerging patterns in responses to our questions. We were able to predict responses to many questions. The interview process became more and more mechanical--fewer and fewer "surprises" occurred. The most stimulating part of the interview process was the opportunity to converse with our respondents before and after the interview. Appreciating the emerging obstacles to meaningful interviews, and recognizing that merely gathering more data was not worth the investment of time, energy, and money, we decided, upon completion of eighty-two interviews, to construct a mailed questionnaire. In part, this decision reflected a decision not to probe selected topics in depth during a new set of interviews but rather to broaden the data base on certain topics.

The Mailed Questionnaire

The questionnaire was much shorter than the interview schedule; it covered what we considered "key" themes based on our interview experience, e.g., social and political activities, orientation to the norms of science, and conditions of work. Letters of inquiry were mailed to the chairmen of all science departments at the four universities selected as research sites for this phase of the study requesting the names of visiting foreign scientists who would be in residence during the summer of 1970. After a short pre-determined waiting period, questionnaires were mailed to all of the individuals whose names we had received, or two-hundred sixty-five scientists. The cover letter included with the questionnaire requested a response within three weeks; no follow-up letters were mailed. These less than optimal procedures were dictated by time/cost factors. Nonetheless, we expected, given the high return rates on mailed questionnaires associated with the study of professionals, at least a fifty percent return. Our actual return rate was 53.0 percent, or 140 usable questionnaires. No differences were discernible betwen respondents and nonrespondents in terms of the admittedly minimal amount of information we had available for analysis, i.e., university affiliation, department, and field.

The returned questionnaires, together with the interviews, gave us a total N of 222. Our sample is relatively homogeneous; most of the scientists are in the physical and biological sciences working on theoretical or experimental "basic" problems. They are evenly distributed by "level of development" of home country. And they are relatively homogeneous on such basic attributes as age, marital status, and sex. These and other basic characteristics of the sample are discussed and presented in below.

I consider my sample a "case," an empirical basis for the conceptual analyses that form the body of my thesis. The significance of generalizing my findings to a larger population can be evaluated to some extent by comparing the characteristics of the sample with the characteristics of visiting foreign scholars (Tables 9 and 10, pp. 48 and 49).

The data for this study have been organized in tables reporting percentage responses. Given the quality of data and my research objectives, I have organized the data in the simplest manner, relying on this presentation to suggest relationships which are incorporated in my conceptual analysis. It should be noted, finally, that time/cost factors often necessitated proceeding hastily where more energy should have been devoted to codification, theory, and pre-tests. While we had considered a limited case study at one university, and would argue that under the circumstances such a study might have been more appropriate, the stimulation of ideas provided by this research experience was possibly not achievable, in the same degree and quality, under limited case study conditions.

Level of Development

Bendix (1964: 5) defines three large-scale social processes important in the modern history and contemporary situation of nation-states: industrialization, modernization, and development. Industrialization refers to the "economic changes brought about by a technology based on inanimate sources of power as well as on the continuing development of applied scientific research." Modernization refers to "all those social and political changes that accompanied industrialization in many countries of Western civilization. Among these are urbanization, changes in occupational structure, social mobility, development of education--as well as political changes from absolutist institutions to responsible and representative governments, and from a laissez-faire to a modern welfare state." Finally, development is "used where reference is made to related changes in both the technical-economic sphere (industrialization) and the social-political sphere (modernization)."

Within this framework, two types of contemporary societies (nation-states) can be identified; developed, and developing. Developed societies are industrialized and modern; developing societies are industrializing and modernizing. In classifying respondents' home countries, I have followed, with some modifications, the schema of Harbison and Myers (1964: see Appendix A). They identify four levels of development based on a composite index of human resources. Their index includes a technical-economic and a social-political dimension; it is thus essentially consistent with Bendix's definition of development. I have modified their schema by collapsing the first three levels of development and defining societies at those levels as "developing"; societies at the fourth level are defined as "developed." This modification is justified by (1) the relatively small size of our proposed sample and the fact that we did not know in advance the distribution of scientists by home country at the universities selected as research sites; (2) the relatively narrow range of index numbers between levels I and II compared to the relatively wide range of index numbers between levels III and IV. The latter range is substantially decreased if the United States, given its high index, is considered a special case; this increases the degree of homogeneity in level IV; (3) an expectation based on prior studies that there would be few if any scientists in our sample from countries in levels I and II.

While there have been valid questions raised about the empirical basis of the Harbison-Myers schema, it does provide at least a crude measure of level of development. The measure is especially relevant for my study given Harbison and Myer's use of a "human resources" index and my focus on "strategic human capital" in a modernizing context. This concept of development classifies nation-states within an international stratification system based on an index of human resources development. It implies neither unilinear nor unidimensional assumptions about societal processes.

Responses were relatively homogeneous along this dimension; there was no meaningful way to determine "significance" for small differences in percentage distributions by level of development on the attributes I have analyzed. The data, and my analysis, suggest the reasonableness of a "no difference" assumption. For this reason, level of development does not appear as an attribute for cross-classification (Vanderpool, 1971).

Basic Characteristics of the Sample[1]

The following tables summarize the basic characteristics of our interviewees and questionnaire respondents. Several characteristics should be especially noted. Not unexpectedly, men outnumber women in the sample by about ten to one (Table 1). Approximately three-quarters of our respondents are 35 years old or younger (Figure 1). This statistic, in conjunction with the fact that more than

[1]Unless otherwise noted, Total N = Base N (i.e., no discrepancies) for interview and/or questionnaire data summarized in the following tables.

TABLE 1

DISTRIBUTION OF RESPONDENTS BY SEX

Sex	Respondents	
	N	%
Male	203	91.5
Female	19	8.5
Total	222	100.0

half of our respondents have received their Ph.D. or M.D. within the last five years (Table 2), is the basis for defining our sample as a segment of the "younger generation" of scientists.

Mean age (X)	= 32.0 years
Range	= 22-67 years
Percent 35 years old or younger	= 76.0%

Figure 1. Summary Statistics on Distribution of Respondents by Age in Years

Tables 3 and 4 indicate the essentially equal distribution of our respondents between "developed" and "developing" countries; they are also equally distributed by "field,"

TABLE 2

DISTRIBUTION OF RESPONDENTS BY YEARS IN WHICH THEY WERE AWARDED THEIR UNDERGRADUATE AND GRADUATE DEGREES

Awarded	Degree					
	B.A./B.S.		M.A./M.S.		Ph.D./M.D.	
	N	%	N	%	N	%
1955 or earlier	32	17.1	16	12.1	8	4.4
1956-1965	146	78.1	90	68.1	70	39.0
1966 or later	9	4.8	26	19.8	102	56.6
Total	187[a]	100.0	132[b]	100.0	180[c]	100.0

[a]N = 222. Number of "no answer" = 32; "no degree" = 3.

[b]N = 222. Number of "no answer" = 61; "no degree" = 29.

[c]N = 222. Number of "no answer" = 37; "no degree" = 5.

TABLE 3

DISTRIBUTION OF RESPONDENTS BY LEVEL OF DEVELOPMENT OF BIRTHPLACE, AND FIELD[a]

Field	Level of Development of Birthplace			
	Developed		Developing	
	N	%	N	%
Physical science	44	40.6	51	44.7
Biological science	58	53.8	57	50.0
Social science	6	5.6	6	5.3
Total	108	100.0	114	100.0

[a]106 citizens (89.1%) of developed countries are citizens of the developed country they were born in; 91 citizens (92.8%) of developing countries are citizens of the developing countries they were born in; 13 citizens (10.9%) of developed countries are natives of another developed country; 7 citizens (7.2%) of developing countries are natives of another developing country.

TABLE 4

DISTRIBUTION OF RESPONDENTS BY LEVEL OF DEVELOPMENT OF HOME COUNTRY (CITIZENSHIP), AND FIELD[a]

Field	Level of Development, Home Country			
	Developed		Developing	
	N	%	N	%
Physical science	49	41.2	43	43.9
Biological science	63	52.9	50	51.0
Social science	7	5.9	5	5.1
Total	119	100.0	98	100.0

[a]N = 222. Number "indeterminate" = 5.

except for the social scientists. In conjunction with Table 5, the notes for Tables 3 and 4 provide basic information on the cross-cultural experiences of our respondents: in summary, (1) an overwhelming proportion of our respondents are citizens of the countries they were born in, (2) nearly sixty percent 60% have never visited a developed country for scientific study or research; more than eight 8% percent have never traveled to a developing country for study or research (Table 5), (3) only 2.5 percent of our interviewees are children of a third-cultural marriage, i.e., the marriage of citizens of two different countries (Table 6), (4) approximately ninety percent of our interviewees are married to spouses whose country of birth is the same as theirs (Table 7).

TABLE 5

DISTRIBUTION OF RESPONDENTS BY NUMBER OF CROSS-NATIONAL TRIPS[a] FOR SCIENTIFIC STUDY OR RESEARCH, BY LEVEL OF DEVELOPMENT OF COUNTRY VISITED

Number of Trips	Level of Development of Country Visited			
	Developed		Developing	
	N	%	N	%
None	127	57.8	184	82.9
One	51	23.0	28	12.6
Two	24	10.1	4	1.8
Three	15	6.8	2	0.9
Four or more	5	2.3	4	1.8
Total	222	100.0	222	100.0

[a]Not including the trip that brought them to the United States for this visit.

TABLE 6

DISTRIBUTION OF INTERVIEWEES BY PARENTAL THIRD-CULTURAL MARRIAGE (MARRIAGE OF CITIZENS OF TWO DIFFERENT COUNTRIES)

Parental Third-Cultural Marriage	Respondents	
	N	%
Yes	2	2.5
No	79	97.5
Total	81[a]	100.0

[a]N = 82. Number of "no answer" = 1.

TABLE 7

DISTRIBUTION OF MARRIED INTERVIEWEES BY WHETHER SPOUSE'S BIRTHPLACE IS THE SAME AS THEIRS OR NOT

Spouse's Birthplace	Respondents	
	N	%
Same	57	90.5
Different	6	9.5
Total	63	100.0

There is one positive index of psychic mobility among our respondents: nearly seventy 70% percent experienced some form of "regular" interaction with foreign scientists in their home country (Table 8). It should be noted, however, that when we probed on this question among our interviewees this interaction was described as minimal and superficial. For example, such "interaction" may have consisted of attending a lecture by a visiting foreign scientist.

TABLE 8

DISTRIBUTION OF RESPONDENTS BY WHETHER OR NOT THEY INTERACTED REGULARLY WITH FOREIGN SCIENTISTS IN THEIR HOME COUNTRY

Responses	Respondents	
	N	%
Yes	143	67.0
No	71	33.0
Total	214[a]	100.0

[a]N = 222. Number of "no answer" = 8.

Tables 9 and 10 provide comparative data which illustrate that in spite of the sampling difficulties we encountered our sample is somewhat representative of the distribution of visiting foreign scientists, according to statistics published in Open Doors. These data are not strictly comparable, because they include non-scientists;

TABLE 9

DISTRIBUTION OF FOREIGN POSTDOCTORALS (ALL FIELDS) IN THE UNITED STATES, BY WORLD REGION AND LEVEL OF DEVELOPMENT OF HOME COUNTRY, 1967[a]

World Region	Level of Development of Home Country					
	Developed		Developing		Total	
	N	%	N	%	Base N	%
Africa	0	0.0	96	100.0	96	100.0
West Asia	147	16.0	769[b]	84.0	916	100.0
South America	102[c]	38.5	164	61.5	266	100.0
East Asia	609[d]	64.0	347	36.0	956	100.0
Australasia	212	72.5	79	27.5	291	100.0
Europe	1532	77.4	451	22.6	1983	100.0
North America (except U.S.)	264[e]	78.4	72	21.6	3336	100.0
Total	2866	59.0	1978	41.0	4844	100.0

[a]Based on Table B-3, "Foreign Postdoctorals by Country of Origin, 1967," in The Invisible University (1969: 305-308).

[b]621 from India.

[c]All from Argentina.

[d]All from Japan.

[e]All from Canada.

TABLE 10

DISTRIBUTION OF RESPONDENTS BY HOME COUNTRY (CITIZENSHIP), COMPARED WITH DISTRIBUTION OF VISITING FOREIGN SCHOLARS IN THE UNITED STATES

Countries	Respondents		VFS[b]	
	N	%[a]	N	%
United Kingdom	33	15.0	1424	13.3
India	30	13.7	1244	11.6
Japan	26	11.8	1117	10.4
Germany	16	7.3	727	6.8
China	14	6.4	1.2, 124[c]	3.8, 406
Australia	10	4.6	359	3.3
Canada	8	3.6	529	4.9
Israel	8	3.6	315	2.9
Czechoslavakia	6	2.7	120	1.1
Korea	5	2.3	211	2.0
Switzerland	5	2.3	205	2.0
Italy	5	2.3	293	2.7
Chile	4	1.8	--	--
France	4	1.8	404	3.8
Egypt	3	1.4	118	1.1
Pakistan	3	1.4	--	--
Poland	3	1.4	137	1.3
Turkey	3	1.4	--	--
Brazil	2	0.9	113	1.1
Colombia	2	0.9	--	--
Greece	2	0.9	--	--
Hong Kong	2	0.9	--	--
Netherlands	2	0.9	136	1.3
Norway	2	0.9	--	--
Spain	2	0.9	138	1.3
Burma	1	0.5	--	--
Costa Rica	1	0.5	--	--
Guyana	1	0.5	--	--
Indonesia	1	0.5	--	--
Iran	1	0.5	--	--
Ireland	1	0.5	--	--
Jordan	1	0.5	--	--
Malaysia	1	0.5	--	--
Nepal	1	0.5	--	--
New Zealand	1	0.5	--	--
Okinawa	1	0.5	--	--
Peru	1	0.5	--	--
Philippines	1	0.5	174	1.6

TABLE 10 (Continued)

Countries	Respondents N	Respondents %[a]	VFS[b] N	VFS[b] %
South Africa	1	0.5	--	--
Sweden	1	0.5	116	1.1
Syria	1	0.5	--	--
Thailand	1	0.5	--	--
Venezuela	1	0.5	--	--
Yugoslavia	1	0.5	126	1.2
Argentina	--	--	165	1.5
Belgium	--	--	104	1.0

[a]Total N for our respondents = 222; Base N = 219. Three respondents could not be classified by home country.

[b]Based on "Leading Nationality Groups of Foreign Faculty Members and Scholars, 1967-1968" (IIE, 1967: 8).

[c]Figures (N, %) are for "China Unspecified" and "Republic of China" respectively. Only two of our respondents were classified as "China Unspecified."

but, as I noted above, more than three-fourths of the "visiting foreign scholars" are in the physical, biological, medical, engineering, and social sciences. I will refer later to the data in Table 9; but note that about sixty percent of foreign postdoctorals in the United States are from developed countries. The "favored status" of developed countries in sending scientists to the United States is further reflected in Table 10.

Finally, Tables 11 and 12, and Figures 2 and 3 summarize the data on marital status, children, and spouses. More than seventy percent of our respondents are married. Among our interviewees, nearly eighty percent are married, and the overwhelming majority of these scientists are accompanied by their families.

TABLE 11

DISTRIBUTION OF RESPONDENTS BY MARITAL STATUS

Marital Status	Respondents	
	N	%
Married	158	71.3
Single	61	27.4
Other	3	1.3
Total	222	100.0

TABLE 12

DISTRIBUTION OF INTERVIEWEES BY MARITAL STATUS

Marital Status	Respondents	
	N	%
Married	63	77.0
Single	19	23.0
Other	--	--
Total	82	100.0

Number of interviewees married = 63

Number of children = 102-(Mean ($\overline{X}$)) = 1.6 children

Range = 0 to 5 children

Number of interviewees reporting "no children" = 15

Number of interviewees reporting "3 or more children" = 14

Figure 2. Number of Children Among Married Interviewees

Number of interviewees married	= 63	
Number accompanied by spouse	= 58	(92.0%)
Number not accompanied by spouse	= 5	(8.0%)
Number of interviewees with children	= 48	
Number accompanied by family	= 43	(89.5%)
Number not accompanied by family	= 5	(10.5%)

Figure 3. Summary Statistics on Spouse and Family (Spouse and Children), Interviewees

CHAPTER II

WORK AND THE THIRD-CULTURAL MILIEU

Adam Smith, Karl Marx, and Thorstein Veblen are among the outstanding contributors to the classical examination of work as a significant determinant of human activity and patterns of thought (e.g., world-views, ideologies, and cognitive mappings). The literature on work, occupations, and professions indicates that "occupational cultures (rooted in common tasks, work schedules, job training, and career patterns) are sometimes better predictors of behavior than both social class and pre-job experience" (Wilensky, 1961: 521-522). Goblot (1925: 38) noted that, "Nothing stamps a man as much as his occupation. Daily work determines the mode of life; even more than the organs of the body, it constrains our ideas, feelings, and tastes." The most unequivocal expression of this perspective on work, as recently formulated by Friedson (1970: 89-90; Cf. Becker, 1964), is that "what people do is more an outcome of the pressures of the situation they are in than of what they have earlier 'internalized.'"

Scientific occupations are generally classified among the professions;[11] and professions can be considered ideal-types of occupational institutions (Vollmer and Mills, 1966: 2) characterized by a body of "systematic knowledge or doctrine acquired only through long prescribed training" (Wilensky, 1964: 138). Professionalization (both as a group process and as a process of socialization for the individual who enters a profession) creates a work milieu which absorbs the greater part of an individual's thoughts and activities (Greenwood, in Vollmer and Mills, 1966: 17). In terms of psychic investments and day-to-day activities, work becomes life (see, for example, Hall, 1948; Caplow, 1954; Form, 1946). The impact of professional socialization in science is greater to the extent that a given work environment is standardizable, and in fact standardized, across a variety of organizational, institutional, and cultural settings.

The following working hypothesis was introduced above (p. 23): To the extent that the conditions of their work are similar (homogeneous), the ideas and activities of scientists will be similar (homogeneous). Ultimately the question arises, given a set of work conditions, what specific ideas and activities are likely to emerge, and what specific ideas and activities are likely to be inhibited. The test of my working hypothesis is based on the "index of qualitative variation," or IQV (Mueller and Schuessler, 1961: 177-179). The IQV analysis precedes my discussion of work conditions among our respondents, the effects of these conditions on their role repertoire (Biddle and Thomas, 1966: 59), and the implications of my findings for understanding the role of visiting foreign scientists in third-cultural perspective.

independent dependent variables

If conditions of work, and "ideas and activities" are considered two sets of attributes, then I have in effect defined the former as independent and the latter as dependent attributes. Corroboration of my working hypothesis is based on constructing a mean IQV for each set of attributes, and establishing that the resulting indices for each set of attributes exhibit comparable degrees of homogeneity. The index is computed as follows:

$$\text{IQV} = \frac{\text{total observed differences}}{\text{maximum possible differences}} \text{ X } 100$$

The index varies from zero (maximum homogeneity) to 100 percent (maximum heterogeneity). In order to utilize the index as a measure of homogeneity, a cut-off point had to be set which would determine whether any given set of responses was to be classified as "homogeneous" or "heterogeneous." The cut-off was established through a trial-and-error procedure at seventy-five percent; that is, an index of seventy-five percent or higher defines a heterogeneous set of responses, and an index of seventy-four percent or lower defines a homogeneous set of responses. The specific procedures and rationales involved in establishing the cut-off, and in calculating the IQV's are discussed in Appendix B.

The use of the IQV is not, in this analysis, without some ambiguity. For example, in establishing the mean IQV for conditions of work, a number of possibilities emerge. If "conditions of work" is defined to include (1) whether the scientist's research is "applied" or "basic," (2) the setting for his research (e.g., laboratory, or office), (3) the number of persons in the work group, and (4) the extent of financial support needed for his research, the mean IQV (i.e., the mean of the IQV's for each set of responses) is 50.0 percent, much below the seventy-five percent cut-off (Tables 14-17 below). For the "selected aspects of scientific work," with categories intact, the mean IQV is 79.8 percent; but it is possible that the response categories for these items ("definitely characteristic," "somewhat characteristic," and "not at all characteristic" on the interview schedule, and "great part," "some part," "no part" on the questionnaire) do not discriminate meaningfully between "definitely" and "somewhat," and "great" and "some." If the mean IQV is re-calculated after collapsing these categories (thereby dichotomizing all responses), then the mean IQV is 64.3 percent (Table 13). The mean IQV for all conditions of work then is 58.6 percent. In no case is the IQV for all items which can be

TABLE 13

DISTRIBUTION OF RESPONDENTS BY THE EXTENT TO WHICH THEIR RESEARCH HAS BEEN CHARACTERIZED BY SELECTED ASPECTS OF SCIENTIFIC WORK

Aspects of Work	Characteristic of Research[a]									
	Definitely		Somewhat		Not at All		Total		IQV	
							Base[g]		Unc.	Coll.[b]
	N	%	N	%	N	%	N	%	%	%
Theory	64	31.9	90	44.7	47	23.4	201	100.0	96.5	71.5
Math and Statistics[c]	40	30.8	86	66.1	4	3.1	130	100.0	70.3	11.9
Methodology	86	43.0	70	35.0	44	22.0	200	100.0	95.5	68.6
Experiment	97	46.2	46	21.9	67	31.9	210	100.0	96.0	85.0
Clinical Work[d]	16	8.4	24	12.6	150	79.0	190	100.0	53.0	66.5
Technology[e]	20	10.0	38	19.0	142	71.0	200	100.0	67.5	82.4
Empirical/ Descriptive[f]	--	--	--	--	--	--	--	--	--	--

TABLE 13 (Continued)

Aspects of Work	Characteristic of Research[a] Definitely N	Definitely %	Somewhat N	Somewhat %	Not at All N	Not at All %	Total Base[g] N	Total %	IQV Unc. %	IQV Coll.[b] %
							Mean IQV		79.8	64.3

[a]Note that there is a discrepancy between the response categories used in the questionnaire (question 26), "great part," "some part," and "no part," and the response categories used in the interview schedule and in this table (question 198). In constructing the questionnaire, we felt obligated to change the phrasing of the question, and the response categories, because of some communication difficulties encountered on the parallel interview question.

[b]In the first column, the IQV's have been calculated for the existing categories, "Definitely," "Somewhat," and "Not at All." In the second column, the IQV's have been calculated for the collapsed categories as explained in the text.

[c]This aspect does not appear in the interview schedule. N, therefore, is 140.

[d]Refers to application of research findings to animal and/or human patients or clients.

[e]Includes applied research, research and development, and engineering. The categories "engineering" and "technological," which appear respectively in the questionnaire and interview schedule, were intended to be comparable; but changing terms may have negated item comparability.

[f]"Empirical" appears in the interview schedule; "descriptive" was substituted in the field, then dropped because of ambiguity.

[g]Except for "Math and Statistics" (see note c), N = 222.

included under conditions of work above the seventy-five percent cut-off.

The expectation that homogeneity of conditions of work is accompanied by homogeneity of ideas and activities is corroborated by the IQV for the set of dependent attributes (Figure 4). The mean IQV for this set of attributes is 69.9 percent.

I have introduced the IQV as a summary statistic. What does the index mean empirically? More than 85 percent of our respondents work in a laboratory <u>or</u> an office most of the time (Table 14). Among our interviewees, nearly 75 percent work in small groups, <u>or</u> with one other person (usually a colleague), <u>or</u> alone; twenty-one percent reported working in "large groups" (Table 15). Approximately 90 percent of our interviewees characterized their work as "Basic" (Table 16); and nearly 65 percent perceive their colleagues defining them as basic research scientists (Table 18). Among the individuals who responded to the question "To what extent does your work entail financial costs requiring large-scale funding (e.g., the type of funding only well-endowed private foundations or government agencies can usually provide)?" more than 40 percent said "to a great extent," and more than 30 percent said "to some extent" (Table 17). The basic science orientation of our respondents is again manifested in their conception of the relative importance of scientific as against

Attribute	IQV	Table	Page
Colleagues' definition of visitor's role	65.6	18	65
Factors in problem selection	57.9	19	67
Attributes to be remembered for	82.0	20	68
Persons to be remembered by	68.0	21	68
U.S. work expectations	97.0	22	71
Work involvement, U.S./home country	99.0	23	72
Authority patterns, perceived differences	96.0	24	73
Scientists in politics	86.0	26	94
Respondents' social/political activities	90.0	27	95
Involvement in change	35.2	28	95
Social responsibility in science, membership	27.4	29	96
Purpose of visit to U.S.	70.0	30	105
Factors in work location	47.5	33	130
Sense of social responsibility	83.0	34	131
Anticipated consequences of research	83.0	35	133
Importance of scientists in development	46.0	36	134
Optimism, home country's future	70.0	37	134
Optimism, world's future	66.6	38	135
Willingness to change profession	70.0	39	146
Publications, journal articles	88.0	40	147
Publications, books	59.0	40	147
Normative orientation, home country	62.9	41	151
Plans after visit, geographical	80.5	43	166
Accepting work outside home country	71.5	46	173
Perceived influence of national identity	64.5	49	177
Scientific gatherings outside home country	78.9	50	178
Belief about change in science	21.0	59	219
Freedom to communicate internationally	92.5	--	
	Mean IQV = 69.9		

Figure 4. IQV's for the Dependent Attributes Discussed or Otherwise Presented in the Text

TABLE 14

DISTRIBUTION OF RESPONDENTS BY WORK SETTING RANKED "FIRST" IN TERMS OF AMOUNT OF TIME SPENT IN THAT SETTING

Work Setting Ranked First	Respondents		IQV
	N	%	%
Laboratory	146	68.5	
Office	45	21.2	
Other	22	10.3	
Total	213[a]	100.0	37.2[b]

[a]N = 222. Number of "no response" = 9.

[b]Based on collapsing the first two "settings," laboratory and office; these two settings, relative to the other settings, are "isolating" environments. This is discussed below in my analysis of the isolating effect of work conditions.

TABLE 15

DISTRIBUTION OF INTERVIEWEES BY NUMBER OF PERSONS IN WORK GROUP[a]

Number of Persons in Work Group	Respondents		IQV
	N	%	%
8 or more (large group)	17	21.2	
2-7 (small group)	39	48.6	
1	6	4.0	
None (works alone)	21	26.2	
Total	80[b]	100.0	67.0[c]

[a]Based on answers to the question, "During the last five years, how many people have you usually worked with on each of your studies?"

[b]N = 82. Data for two respondents is missing on this item.

[c]Based on collapsing categories "2-7," "1," and "None," to contrast "large group" work and "small group" work (the latter now including "working alone").

TABLE 16

DISTRIBUTION OF INTERVIEWEES BY THEIR CHARACTERIZATION OF THEIR PRESENT WORK: BASIC OR APPLIED[a]

Characterization of Present Work	Respondents		IQV
	N	%	%
Applied	6	9.9	
Basic	55	90.1	
Total	61[b]	100.0	35.6

[a]Based on responses to question 190, interview schedule. Responses "a," "b," "c," "d," were coded "applied." "G" was coded "basic." "E" was dropped because of ambiguity; some respondents interpreted the question in applied terms, others in basic terms; the response to "basic" is therefore under-represented.

[b]N = 82. Number of "no answer" = 3; number dropped for "E" (see prior note) = 18.

TABLE 17

DISTRIBUTION OF RESPONDENTS BY EXTENT OF LARGE-SCALE FUNDING REQUIRED FOR THEIR RESEARCH

Extent of Large-Scale Funding Required	Respondents		IQV
	N	%	%
Great extent	97	47.0	
Some extent	72	34.7	
Not required	38	18.3	
Total	207[a]	100.0	60.0[b]

[a]N = 222. Number of "no response" = 15.

[b]Based on collapsing categories "great extent" and "some extent," to contrast "required" and "not required."

TABLE 18

DISTRIBUTION OF INTERVIEWEES BY PERCEIVED COLLEAGUES' DEFINITION OF THEIR PROFESSIONAL ROLE

Perceived Colleagues' Role Definition	Respondents		IQV
	N	%	%
Basic research scientist	32	64.0	
Applied research scientist	4	8.0	
Teacher/researcher	12	24.0	
Other	2	4.0	
Teacher	0	0.0	
Total	50[a]	100.0	65.6[b]

[a]N = 82. Number of "no answer" = 32. This question was difficult for some interviewees to respond to.

[b]Based on collapsing "basic research scientist" and "teacher/researcher" to contrast "basic research" versus "other" role definition. The rationale for this is that "teacher/researcher" for most of our interviewees implies "basic research" as a primary, "teaching" as a secondary role.

extra-scientific factors in determining selection of research problems (Table 19). All of these responses considered together outline a profile of scientists working alone or in small groups with colleagues, pursuing basic science in the hope of making a basic, and lasting contribution to science (see Tables 20 and 21), their interests centered on theory and/or experimentation requiring consistent and continuous research involvement.

These conditions of work tend to isolate the visiting foreign scientist from extra-scientific situations and to afford him little opportunity to engage in extra-scientific activities. This pattern is reinforced by several factors which are more or less directly related to conditions of work. The visitor is isolated from the teaching and administrative responsibilities and obligations associated with the full-time, permanent faculty role; he is isolated from the faculty career-tenure line; scarcity of time (due, for example, to visa restrictions) and funds dictate a relatively strict schedule of research and writing; his "supervisor" or "boss" (the words used by most of our interviewees in referring to their project directors), usually a senior member of the tenured faculty, and/or the department chairman actively intervene in situations that would require him to take time out from his research--they "take care" of things for him, e.g., payroll problems, acquisition of research space and materials, and personal problems.

TABLE 19

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY IMPORTANCE OF PROBLEMS FACING MANKIND, HOME COUNTRY, AND BASIC SCIENCE IN DETERMINING THEIR CHOICE OF RESEARCH PROBLEMS

Rated Importance	Source of Problems					
	Mankind		Home Country		Basic Science	
	N	%	N	%	N	%
Very important	39	29.3	40	30.3	107	77.5
Somewhat important	59	44.4	55	41.7	25	18.1
Not at all important	35	26.3	37	28.0	6	4.4
Total[a]	133	100.0	132	100.0	138	100.0
IQV[b]	76.5		80.5		16.7	

[a]N = 140. Several respondents failed to respond on each item.

[b]Based on collapsing "very" and "somewhat" important; mean IQV = 57.9.

TABLE 20

DISTRIBUTION OF INTERVIEWEES BY WHAT THEY WOULD MOST LIKE TO BE REMEMBERED FOR

Attribute	Respondents N	Respondents %	IQV %
Basic contribution to science	39	52.7	
Personal character	6	8.1	
Contribution to human welfare	9	12.1	
Nothing specific	15	20.3	
Other	5	6.8	
Total	74[a]	100.0	82.0

[a]N = 82. Number of "no answer" = 8.

TABLE 21

DISTRIBUTION OF INTERVIEWEES BY PERSONS THEY WOULD MOST LIKE TO BE REMEMBERED BY

Persons	Respondents N	Respondents %	IQV %
Scientists	34	64.2	
"World"	7	13.2	
Friends	6	11.3	
Other	6	11.3	
Family	0	0.0	
Total	53[a]	100.0	68.0

[a]N = 82. Eight "not applicable"; 21 "no answer."

The visitor is further isolated by virtue of his non-citizen, transient status-position in the community. Many of our respondents referred to this as an important pre-requisite of the visitor's role; it allows them more uninterrupted time for research than they would have in their home country. The visitor has virtually none of the day-to-day responsibilities and obligations of the permanent members of a community or neighborhood.

The tight, rigorous work schedule makes it difficult for the visitor to become involved in the life of the community, in the "culture" of the United States. In some cases this isolation is reinforced by a spouse who, because he or she lacks professional ties in the community or university, and/or has language difficulties, does not encourage the visitor to enter into the culture, e.g., by eating out, or sightseeing, or socializing regularly with people in the community. The objection raised by such a spouse in one instance was that she did not want to be "embarrassed." Her husband, a young Indian physical scientist, wanted to get out more, to "eat hamburgers and drink Cokes," but could not do so because of his wife's attitude. In another case, however, a type of "involvement" was effected by a visitor's wife who obtained employment in a local shop.

The major components of the third-cultural milieu from the perspective of the visiting foreign scientist are the department, the university, and the community; within that milieu, conditions of work are the basic determinants of his third-cultural experience.

There are two interrelated consequences of working in a milieu such as I have been describing: (1) social isolation--isolation from non-work-related milieu, and (2) role intensity--the role repertoire of the visiting foreign scientist is limited; his scientific activities define a major proportion of his total activity profile.

Social isolation has two dimensions: one is isolation from the career-oriented professional sub-culture of the academic community he is temporarily a part of; the second is isolation from the community within which the university is located. There is, in brief, "on the job" isolation and "off the job" isolation.

Role intensification is stimulated by the continuity of conditions of work between the United States and the visitor's home country. The degree of continuity is indicated by our interviewees' responses to the question, "Was there anything unanticipated, or surprising about your work experiences in the United States?" Nearly 60 percent said "No"' conditions of work are not, in general, much different than conditions in the home country (Table 22). The differences encountered, however, were rarely differences in the conditions of work I discussed above. A visitor from England, for example, commented on the relatively poor quality of laboratory equipment; the equipment

TABLE 22

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THERE WAS ANYTHING UNANTICIPATED ABOUT THEIR WORK EXPERIENCES IN THE UNITED STATES

	Respondents		IQV
Responses	N	%	%
Yes	33	41.8	
No	46	58.2	
Total	79[a]	100.0	97.0

[a]N = 82. Number of "no answer" = 3.

here is purchased by the department or university, whereas in England equipment is made in a campus workshop by scientists. Several scientists from developing countries commented on the greater accessibility of quality equipment and materials here, and on the higher degree of professional commitment to science among their American colleagues in contrast with the "poor scientific attitude" of their home country colleagues. But "conditions of work," which may have been more nearly ideal for some visitors, were not significantly different from conditions of work in their home countries. Coming to the United States appears to implicate the visiting foreign scientist in an environment that not only supports his prior level of role intensity but significantly contributes to role intensification. Indeed, the differences between conditions of work here and those in the home country seem to be primarily differences which increase role intensity.[22]

A more ideal "technology" (more easily accessible and of higher quality) may make work more satisfying and encourage the visitor to spend longer hours working than he is used to; the evidence for this in terms of a comparison of work involvement here and in the home country is not, however, unequivocal (Table 23). It is somewhat more clear

TABLE 23

DISTRIBUTION OF RESPONDENTS BY DEGREE OF WORK INVOLVEMENT IN U.S. COMPARED WITH WORK INVOLVEMENT IN HOME COUNTRY

Degree of Involvement in Work, U.S. vs. Home Country	Respondents N	Respondents %	IQV %
Higher than in home country	92	47.5	
The same or lower than in home country	102	52.5	
Total	194[a]	100.0	99.0

[a]N = 222. Number of "no answer" = 28.

that differences in perceived patterns of authority in the work situation do reflect conditions conducive to role intensification. Sixty percent of our respondents expressed an awareness of such a difference: their relationships with supervisors (or "bosses"), and with department chairmen were more "democratic" (less "authoritarian") here relative to their home country experiences (Table 24).

TABLE 24

DISTRIBUTION OF RESPONDENTS BY WHETHER OR NOT THEY HAVE EXPERIENCED DIFFERENCES BETWEEN AMERICAN AND HOME COUNTRY PATTERNS OF AUTHORITY IN THE WORK SETTING

Differences Experienced	Respondents		IQV
	N	%	%
Yes	120	60.0	
No	80	40.0	
Total	200[a]	100.0	96.0

[a]N = 222. Number of "no answer" = 22.

Conditions of Work as Independent Attributes and Their Impact on Social Isolation and Role Intensification

The foregoing discussion, in addition to being a presentation of the results of my empirical study of conditions of work among visiting foreign scientists, can be considered a prelude to examining the relationship between work conditions and social isolation and role intensity. This question cannot, for reasons noted in Chapter I, be examined in systematic relationship to my data. I have, however, considered the question with reference to the data I have collected, and I have identified twelve dimensions of conditions of work in science. These I have outlined below. Each dimension is accompanied by an arrow indicating an hypothesized relationship between the dimension, and social isolation and role intensity. The direction of the arrowhead indicates increasing conduciveness to social isolation and role intensity. Statements of hypotheses for each dimension are presented following the outline of work conditions. All of this is tentative: the dimensions identified may not be, in all cases, mutually exclusive; nor is the set of dimensions or conditions intended to be exhaustive and logically or theoretically closed.

DIMENSIONS OF CONDITIONS OF SCIENTIFIC WORK: A TENTATIVE SCHEMA

Dimensions		Conditions
1. Subject matter	↑	symbolic physical natural social
2. Mode	↑	theoretical experimental clinical
3. Orientation	↑	basic applied
4. Physical setting	↑	none fixed transient
5. Setting dependency	↑	self-dependent physical-dependent natural-dependent technician-dependent colleague-dependent client-dependent other (individual or group)-dependent

Dimensions	Conditions
6. Ego-technics	mental physical verbal-gestural-postural
7. Status-position relations	none peer(s) subordinate(s) superordinate(s)
8. Research costs	none low medium high
9. Technological complexity	high medium low
10. Interaction density	zero low medium high
11. Interaction homogeneity index	unity high medium low
12. Space-time	restrictive expansive

Particular configurations along these dimensions determine the extent to which individuals, groups, and collectivities are likely to be characterized by social isolation and role intensity. What follows are brief descriptions of each dimension, hypothesized relationships, and definitions.

1. Subject matter: the object of investigation; the nature of the things, attributes (including variables) manipulated. The greater the degree to which the subject

matter is "removed," or "abstracted" from human individuals and human society, the more conducive it is to social isolation and role intensification.

2. Mode: the manner in which the subject matter is manipulated. Theoretical, or "mental," manipulation is more likely to isolate the scientist from direct contact with and involvement "in" the subject matter than experimental or clinical manipulation.

3. Orientation: the scientist's objective in studying any particular phenomenon. The two orientations identified are defined as follows: (1) "basic"--science for its own sake, and (2) "applied"--science pursued explicitly with reference to practical, "worldly" problems considered soluble in a technological sense, and applicable in the "real" world. The "basic" orientation is more removed from the practical, the "everyday world," and therefore more conducive to social isolation and role intensity.

4. Physical setting: the nature and "fixedness" of the scientist's physical work environment. "None" in the schema outlined above is characteristic of the (ideal) theoretical mathematician or logician who manipulates his subject matter mentally. "Fixed" settings include, for example, cyclotron or synchrotron laboratories. "Transient" settings include the field settings of, for example, survey researchers in the social, zoological, or geological

sciences. It can be hypothesized that the greatest likelihood of social isolation and role intensity exists within the "none" condition, and the next greatest likelihood in the "fixed" condition.

5. Setting dependency: the focus here is on the kinds of "things" the scientist is "dependent" on in the work environment for pursuing and achieving his goals. For example, the role of "psychotherapist" is meaningful only in relation to the role of a "patient" or "client," thus, the setting dependency for psychotherapy is "client-dependent."[23] The greater the number of human dependencies, and the greater the degree of intimacy in the scientist's relationships with reference to those dependencies (or, possibly, the greater the primacy of "primary" over "secondary" relationships; or again, the greater the probability for such primacy), the less likely is the scientist to be socially isolated, and the less likely he is to be characterized by role intensity.

6. Ego-technics: the query here is, "What human attributes are most prominent (or salient) in the performance of the work role?" For example, the theoretical mathematician can rely primarily on cerebral manipulation of symbols; and even when he wishes to record his thoughts he can do so with the relatively simple skills associated with handling paper and pencil. An experimental physicist, in addition to cerebral manipulations, must rely a great

deal on skills necessary for manipulating more and less complicated physical materials, objects, and machines.

7. <u>Status-position relations</u>: sociologically, this is a self-evident dimension. I am uncertain concerning the nature and significance of this dimension in the context of scientific work, and I have signified this by placing a question mark alongside this dimension in the schema above. The consequences of status-position must be examined at two levels. One is the very specific level of the scientist's day-to-day work experiences: how do "democratic" and "authoritarian" relations affect scientists' ideas and activities; what is the impact of working with peer (colleagues) as opposed to working as a subordinate, or a superordinate on a scientist's ideas and activities? At a second and more general level, the "Matthew effect" and "intellectual phase-looking" must be examined. The former term refers to a phenomenon described by Merton (1968: 58) as "the accruing of greater increments of recognition for particular scientific contributions to scientists of considerable repute and the withholding of such recognition from scientists who have not yet made their mark." The latter term refers to a tendency noted in the experimental determination of physical quantities (Taylor, et al., 1970: 65-66), e.g., measuring the velocity of light: values obtained in numerous and successive

experiments are "fudged" (not maliciously) so that they agree with an initial value obtained earlier by an eminent scientist.

8. Research costs: the impact of "costs" is rather complex. At one level, if research costs are zero, the scientist does not have to depend on other individuals, groups, or collectivities for resources. He is able to maintain a high degree of autonomy. Similarly, at an institutional level, links between a zero costs science and other social institutions are minimal. Increasing research costs in an environment characterized by a scarcity of resources will inevitably create links between science and, for example and especially, government. Such links not only affect autonomy in science, but lead to the creation of new structures, the initiation of new processes, the emergence of new roles in science (e.g., lobby-pressure group links with government, fund-raising by scientists working part- or full-time in pursuit of access to and control over science-related resources).

9. Technological complexity: the greater the degree of technological complexity in a science the more rigorous and systematic the training of the scientist must be at the level of man-machine relations, and the more likely it is that he will experience social isolation and role intensification.

10. Interaction density: here I follow Webster's definition in focusing on "the average number of individuals . . . per space unit." The lower the density (in a laboratory, for example) the higher the social isolation and role intensification.

11. Interaction homogeneity index: the basic query here is how homogeneous the work group is (sociologically) for any given scientist or group of scientists. Homogeneity is conceived to be multidimensional, including nationality, scientific speciality, age, sex, and other attributes. A high degree of homogeneity is conducive to social isolation and role intensification.

12. Space-time: space can be physically restrictive (the work area can be small, and poorly ventilated) or expansive (e.g., a large laboratory offering space for a number of scientists to work and to be relatively mobile). Time can be restrictive (so much work to be done in so much time) or expansive (e.g., research is open-ended insofar as a final, possibly publishable, product is concerned). Restriction-expansion is also more directly related to the nature of the research, e.g., in the case of an experiment which requires a constant "vigil," in contrast to a long-term historical study.

The following scheme (Figure 5) illustrates what these dimensions and conditions mean in terms of social isolation and role intensification. The figure defines two ideal

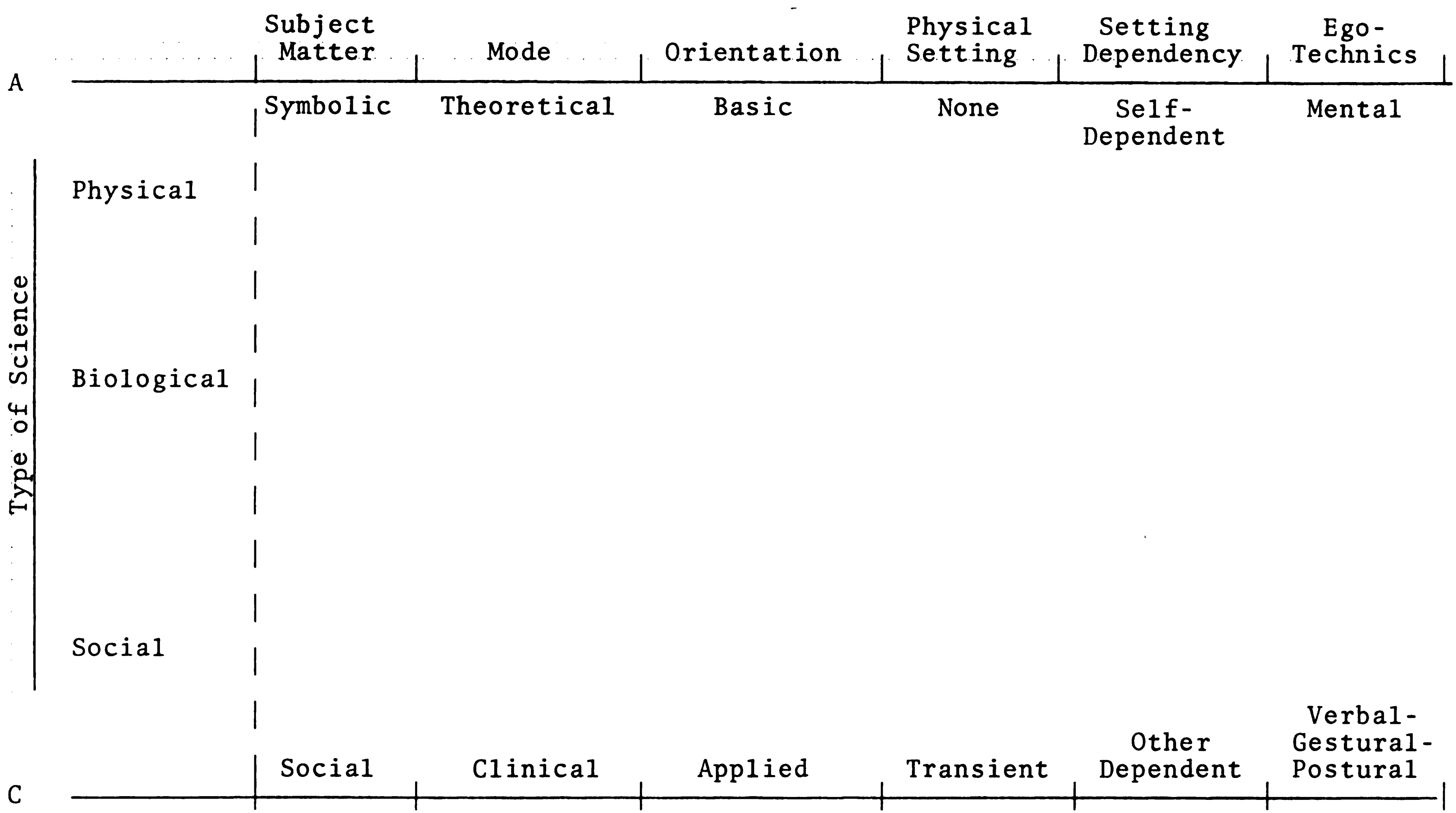

Figure 5. Dimensions and Conditions of Scientific Work in Relation to Social Isolation and Role Intensity

Figure 5 (Continued)

Status-Position	Research Costs	Technological Complexity	Interaction Density	Interaction Homogeneity Index	Space-Time	B
None	None	High	Zero	Unity	Restrictive	HIGH
?	High	Low	High	Low	Expansive	LOW
						D

Social Isolation

Role Intensity

Note: Each column represents a "dimension of work"; the actual conditions of work are placed on a continuum along the dimension. For example, column 1 represents the dimension "subject matter"; the actual conditions of work are, from top to bottom, "symbolic," "physical," "natural," and "social." I have included only the extremes of the conditions continua in this figure; the complete set of conditions for each dimension is outlined on pp. 74-75. Explanatory notes for each dimension will be found on pp. 75-80.

configurations, one for maximum social isolation and role intensification. It should be evident, incidentally, that I have conceived social isolation and role intensification to be functionally interdependent, related directly though not necessarily linearly. An environment conducive to social isolation will give rise to, or reinforce, role intensification.

In constructing Figure 5, I have expressed my awareness of the need to provide a profile of individuals, groups, and collectivities based on "scores" for each dimension. Such a profile would be placed relative to theoretical "horizontal." A profile which connected the top set of conditions (A-B) would coincide with the theoretical horizontal (or profile) I have associated with "highest level of social isolation and role intensity." A "theoretical horizontal" is defined as a horizontal line anywhere in the place which connects items theoretically associated with one another for any given individual, group, or collectivity. The profile for any given individual, group, or collectivity would result in a "best-fitting" horizontal. The closer the best-fitting horizontal to A-B, the higher the expected degree of social isolation and role intensity, the greater the probability that a given individual, group, or collectivity will not be involved in activities related to large-scale social change; more emphatically, higher degrees of social isolation and role intensity will be associated with high probabilities of low degrees of involvement in extra-work activities.

It can be hypothesized that (1) professionalization, because it is conducive to "the invasion of life by work," and (2) bureaucratization, where it tends to introduce, sanction, and maintain strict well-defined control over work conditions and work-roles tend to increase the affinity of the profile horizontal for the theoretical horizontal A-B. These two processes are discussed in some detail in the following chapter.

Within the constraints imposed by this crude schema it appears evident that a profile of our respondents would approximate the theoretical horizontal associated with the highest degree of social isolation and role intensity. In the following paragraphs, I explore some of the consequences of social isolation and role intensity for the extra-work activities of our respondents, and discuss the implications of this for understanding their roles in the third-culture of science.

Work, The Third-culture of Science, and Social Change

The literature on third-cultural milieu is consistent in stressing both the actual and normative (ideal) relationships between science and science-related activities and development (i.e., industrialization and/or modernization), and ecumenization. Educational exchange, institution-building, technical and economic assistance, and the development of national scientific communities are viewed as systems or sub-systems "designed to facilitate the process of modernization" (Useem and Useem, 1968: 43). This view is reflected in the rationales for exchange programs and visiting scholar activities. In a recent study of postdoctoral education in the United States, many university administrators expressed the feeling that international education is "a responsibility of the world's richest country" (NAS, 1969: 209). At a national conference on higher education and development in 1967, a United States State Department official noted that one problem America faces is "how education in America, for the foreign and American student alike, can help bring together the advanced and developing world" (Canter, 1967: 37).[24]

Science is, according to many scholars, the critical activity in national and world development. J. D. Bernal's The Social Function of Science established a Marxist perspective on the relationship between science and social change when it was published in 1939: "It is to Marxism that we owe the consciousness of the hitherto unanalysed driving force of scientific advance, and it will be through the practical achievements of Marxism that this consciousness can become embodied in the organization of science for benefit of humanity" (Bernal, 1939: 415). In a

Festschrift for Bernal published a quarter of a century later (Goldsmith and Mackay, 1966: 55), physicist P. M. S. Blackett, Nobel recipient in 1948, argued that "the West should make the great experiment of sacrificing some of its immediate prosperity to give massive aid to the have-not countries. . . . Scientists and technologists have a special responsibility in this matter, since it is their genius and their skill which alone can bring the material basis of happiness within the reach of all."

Richard Meier reaches similar conclusions in his book, Science and Economic Development. He describes his work as an experimental attempt to judge the impact of progress in science on world economic development. Like Brown (1954), Meier has tried to develop a "readily communicated quantitative framework." He has tentatively identified, for example, the number of calories a human being needs, and the amount of resources available for satisfying human needs for food, clothing, and shelter. Though his conclusions concerning the relationship between science and social change are consistent with Bernal's, Meier's argument is much more rigorous, theoretically and quantitatively.

Silvert, addressing himself primarily to the problems of developing countries, concludes that ". . . the degree of freedom required to make the most rational decisions needed at the level of development of the country concerned may be a functional requisite for self-sustaining growth"

(1969: 435-436). He associates this "degree of freedom" with the claim in science that "freedom is an efficient form of organization" (Polanyi, 1951: 34-35).

The preceding arguments are developed more explicitly by Apter in his <u>The Politics of Modernization</u> (1965). Science, he urges, based as it is on "the need for informatin, verification, experimentation, and empiricism" must ultimately be accepted by the modernizing elites (Apter, 1965: 175).[25] It is through the scientific community that "links are maintained between the industrial nations and those just beginning to industrialize" (Apter, 1965: 439).

Finally, Gilpin has related scientific activity to the economic and technological status of <u>developed</u> nations, noting that "Great Power status accrues only to those nations which are leaders in all phases of basic research and which possess the financial and managerial means to convert new knowledge into advanced technologies" (1968: 25).

The theme uniting these and related conceptions of science and society is an unchallengeable awareness of the function of organized human inquiry in problem-solving at the national and world levels, a function relevant to developed and developing nations, as well as to world development.

Furthermore, many observers believe that (1) there are special skills, knowledge, and techniques appropriate to the solution of developmental problems at all levels, and (2) broad creative and critical scientific imagination is necessary for short-as well as long-term developmental planning. The function of scientific activity as a link between developed and developed countries is under these conditions defined in much more complex terms than simple transfers of technologies and research "know-how," either through (1) transfer of scientific and technological "goods and services," or (2) training foreign personnel. Calder (1970: 268), for example, writes that, "There is every reason why the poor countries should attempt to leapfrog over the obsolescent technologies of the rich . . . imitation of the present rich countries may be quite inappropriate for countries with different climates, cultures and interests. The poor countries must therefore formulate their own visions of the future and experiment with novel technologies themselves. . . ." A similar situation has been noted for developed countries. The European "responses toward the contemporary scientific-technological revolution" does not appear to be dependent "under present conditions on an Atlantic basis through some sort of technological Marshall Plan" (Gilpin, 1968: 459).

There has been widespread affirmation of these ideas (e.g., Brown, 1954; Brown and Harbison, 1957: 78ff; Shils, 1961: 219; Gruber, 1962; Lewis, 1962; Revelle, 1963: 138; Harbison and Myers, 1964: 69; Apter, 1966: 222; Shils, 1966: 212; Shils, 1967: 482-483; Shah, 1967; Myrdal, 1968: 55ff;

Perkins, 1966: 617; Meier, 1966; Stone, 1969: 1118; Halpern, 196: 183; UNESCO, 1963, and 1970). This affirmation entails a definition of the visiting foreign scientist's role in the United States, whether he is from a developed or a developing country. His role, as one of a number of roles in science that link developed and developing countries, is one many scholars consider a model for (if not the only actual) modernizing role. While objections might reasonably be raised against the conception of the scientific role as <u>the</u> modernizing role, there can be little question that it is a critical role in contemporary large-scale processes of social change. The question thus arises: to what extent is the experience of the visiting foreign scientist in the United States linked to large-scale processes of social change; to what extent is his role, considered in terms of how it is initially defined and how it develops thereafter, a "modernizing role," or a role that stimulates an awareness of national and world development?

Tendencies to social isolation and role intensification are not conducive to stimulating and/or reinforcing cognitive or behavioral involvements with processes of social change. The visiting foreign scientists in our sample are implicated in the professional sub-culture of American scientists; concomitantly, their encounter with American society and culture is, under the best conditions, peripheral. Even where respondents expressed a desire to learn more about the

United States, they indicated how little time they had for actually doing so. Several interviewees noted outside the context of the interview proper their "need" to "get away" on weekends, to "relax"; their activities, however, were usually such as to reinforce "off-the-job" social isolation--hiking alone or in small groups, for example, was a favorite form of leisure for several interviewees.

I will say more about the professional sub-culture of American science as our respondents experience it in the following chapter; but with reference to my "conditions of work" hypotheses, the distinction between "basic" and "applied" research as factors in social isolation and role intensity (which is at least intuitively appealing) may be irrelevant. Basic _and_ applied research may, for the visiting foreign scientists, stimulate and/or reinforce social isolation and role intensity. This possibility is suggested by two ideas: (1) that basic research is focused on the advanced theoretical, experimental, and methodological problems defined at the "centers" of the scientific community, and (2) that applied research, financed through private and/or government grants, deals with technological problems of American industry, agriculture, national defense, and more generally health, education, and welfare (Beer and David, 1963: 116-117; NAS, 1969: 205). In the first case, the visitor is being exposed to problem-solving "paradigms" which are not relevant to the scientific-technological problems of his home country; in the second case, he is also participating in scientific-technological activities which may be largely irrelevant to the applied problems of his home country.

I have already made reference to the overwhelming involvement of our respondents in what they refer to in a variety of contexts as "basic research." That their scientific activities are, in fact, irrelevant to the specific developmental problems of their home countries (or the world) is suggested by the data in Table 24.1. Nearly half

TABLE 24.1

DISTRIBUTION OF RESPONDENTS BY RELATIONSHIP BETWEEN PRESENT SCIENTIFIC ACTIVITIES AND SCIENTIFIC ACTIVITIES TO BE PERFORMED WHEN THEY LEAVE THEIR PRESENT POSITIONS[a]

Relationship Between Activities	Respondents	
	N	%
Same activities performed before coming to the United States	87	46.5
Same activities now engaged in	58	31.0
Other	42	22.5
Total	187[b]	100.0

[a]Note that nearly sixty percent of our respondents intend to return home.

[b]N = 222. Number of "no answer" = 35.

of our respondents will return to performing the same scientific activities they were engaged in before coming to the United States. This means for most of them (1) a reduction in the amount of time available for research: about one-third of our interviewees, for example, will be teaching as well as doing research (Table 25); the reduction

TABLE 25

DISTRIBUTION OF INTERVIEWEES BY PROFESSIONAL PLANS FOLLOWING EXPIRATION OF PRESENT ACADEMIC COMMITMENT IN THE UNITED STATES

Plans	Respondents N	Respondents %
University - teaching	7	10.0
research	16	22.8
teaching/research	23	32.8
Industry - research	2	2.9
Government - research	7	10.0
Not certain	15	21.5
Total	70[a]	100.0

[a]N = 82. Number of "no answer" = 12.

will probably be greater for visitors from developing countries who emphasized the lack of full-time research positions, especially in the universities, available to them; (2) the application of skills, knowledge, and techniques learned here to problems which are job-specific and not necessarily relevant to developmental processes; (3) a continuation, even in a limited way, of basic research activities (in the classroom, as well as in the laboratory) which are associated with professional advancement in science--the reference group in that case is "in" the scientific centers, and especially the United States; and (4) no active attempt to make their scientific role relevant to developmental processes; they will take no such initiative, and no stimulation or reinforcement will come from their work environment.

My final statement (number four) concerning the roles our respondents will play in reference to developmental processes is supported by data on their present and past activities as social change agents. Many of our questionnaire respondents felt that "every scientist and scholar should be directly involved in the decision-making process of their country"; approximately 25 percent disagreed with that statement (Table 26). Our respondents in general, however, are distinguished by their lack of involvement in non-scientific organizations and activities at all socio-political levels--neighborhood, community, and national (Tables 27, 28). Still another indication of their "lack of involvement" is the fact that only about eight percent of our interviewees are members of professional associations organized around the goal of promoting social responsibility in science (Table 29).

TABLE 26

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY RESPONSES CONCERNING THE DIRECT INVOLVEMENT OF EVERY SCIENTIST AND SCHOLAR IN NATIONAL DECISION-MAKING

Statement: Every scientist and scholar should be directly involved in the decision-making process of his home country	Respondents		IQV
	N	%	%
Strongly agree	21	15.6	
Agree	54	40.3	
Neither agree nor disagree	25	18.7	
Disagree	26	19.4	
Strongly disagree	8	6.0	
Total	134[a]	100.0	86.0[b]

[a]N = 140. Number of "no answer" = 6.

[b]Based on collapsing "agreement" and "disagreement" categories (i.e., computed from sub-totals with n = 109), and eliminating neutral category.

TABLE 27

DISTRIBUTION OF RESPONDENTS BY WHETHER OR NOT THEY HAVE BEEN INVOLVED IN NON-SCIENTIFIC ORGANIZATIONS OR ACTIVITIES IN THEIR HOME COUNTRY DURING THE LAST FIVE YEARS[a]

Involvement in Non-scientific Organizations or Activities	Respondents N	Respondents %	IQV %
Involved	74	34.4	
Not involved	141	65.6	
Total	215[b]	100.0	90.0

[a]Based on data from items 48 (questionnaire), and 205 and 220 (interview schedule). There were no affirmative responses to question 220, which dealt with national-level decision-making.

[b]N = 222. Number of "no response" = 7.

TABLE 28

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THEY ARE INVOLVED IN BRINGING ABOUT CHANGE IN THEIR HOME COUNTRY[a]

Involvement in Change	Respondents N	Respondents %	IQV %
Involved	8	9.8	
Not involved	74	90.2	
Total	82	100.0	35.2

[a]Based on answers to the question, "Are you involved in bringing about change in your country?" This question was explicated during the interviews to ascertain whether or not the interviewee was consciously and actively working to bring about social and/or political changes in his home country.

TABLE 29

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THEY ARE MEMBERS OF PROFESSIONAL ASSOCIATIONS CONCERNED WITH SOCIAL RESPONSIBILITY IN SCIENCE

	Respondents		IQV
Membership Status	N	%	%
Member	6	7.4	
Not a member	75	92.6	
Total	81[a]	100.0	

[a]N = 82. Number of "no answer" = 1.

Our interviewees were asked to explain their "lack of involvement" in social change (Table 27); the reason most often cited was "too involved in work" (Table 29). It is reasonable to suppose that this "reason" is generalizable to all respondents on all questions dealing with "involvement"; that is, most of our respondents would explain their lack of involvement in non-scientific organizations and activities in terms of the demands of their work.

Work, even in a "third-cultural" setting, can narrow rather than broaden an individual's experience. The disparity between the actual role of the visiting foreign scientist and the role imagined by many students of science and society is sufficient to warrant a close examination of the consequences of international education, exchange programs, and related linkage systems. The work-role of the visitor, our data indicate, so closely tied to American basic science, is rarely defined by the visitor or his hosts specifically in terms of the visitor's potential contribution to his home country's development, or to world development.

What of the visitor's work-role in relation to constructing cooperative links between America and his home country? Except for scientific "elites," such links appear to be rather fragile. Once the visitor returns to his home country, his immediate situation takes priority over his host country situation. To the extent that American scientists remain a part of his network they do so in a predominantly if not exclusively professional way (Cf. Rose and Rose, 1970: 180-181). At the very least, our data do not support the idea that scientists (and "internationally mobile" scientists in particular) are peculiar in the extent to which they manifest a concern for or orientation to large-scale social change. Their "international outlook" gives no evidence of being especially extensive or deeply internalized in comparison to what one might expect to find among other professional collectivities (Cf. Lerner and Teich, 1968).[26]

A Brief Excursus on the "Free Market" Conception of Scientific Talent

To the extent that the preceding discussion is applicable to "international science," and to the extent that the argument is valid, the conception that allowing a "free market" for scientific talent--a "capitalism of intellect"--to operate contributes to the furtherance of human welfare must be challenged. The issue is whether the unimpeded movement of scientific talent on a world market in fact contributes to improving the human condition on a global scale. Grubel's argument (1970: 9-10) is representative of the free market of scientific talent position:

> It is generally tempting to consider the addition to knowledge, the teaching services and leadership provided by . . . foreign-born scientists as a clear gain to the United States and an equivalent loss to the rest of the world. This view fails to take account of several important matters. First, it is misleading to believe that these scientists necessarily would have reached the same level of productivity had they not migrated to the United States. In their native countries they might not have had the necessary laboratory equipment, time for research and stimulating colleagues as they did in the United States. Political and ideological persecution might have reduced their productivity.
>
> Second, scientific knowledge produced by these foreigners is freely available to the rest of the world. . . .
>
> Third, the income from work received by all scientists as a group tends to reflect the expected social value of their contribution to the nation's output . . . the emigration of a scientist tends to leave unchanged the incomes of those remaining behind, since he takes along not only his contribution to the nation's output but also his claim on it.

Gruber's first point ignores the economic distinction between a structure and an aggregate, and what Veblen referred to as "trained incapacity." Boulding (1968: 113) notes that

"Human capital, more than physical capital is a structure rather than an aggregate": a highly trained person does not necessarily add to the productive capacity of a society unless that person fits "into the matrix of information flows in a way that increases the productivity of the society":

> It is quite possible, indeed it has frequently happened, that quite highly trained people may have a strongly negative marginal productivity, especially if they are emotionally immature, insensitive to their own environment and destroy more in the way of structure than they create. There is a good deal also of . . . "trained incapacity" in the case of highly trained individuals who have been trained to do a particular thing and who insist on doing it whether it makes any sense or not. It is not the existing stock of knowledge in a society which determines its rate of development as much as its capacity for learning. Some constellations of knowledge assist this and some do not.

Productivity must also be related to the manpower needs of individual nations and to world development. The level of productivity, and the quality of knowledge associated with the professional training of our respondents is defined within the structure of American science. The Western nations, including the United States, were "forced to build up fundamental science and to explore blindly the hidden qualities of phenomena which some day may be useful; they have learned how to find promising personnel for this work and they have brought some system into the process of invention" (Meier, 1966: 219). The consequence of this history is that the United States now has a heavy demand (an "unlimited" demand according to Perkins, 1966: 617) for high-level manpower.[27] The present movement of scientific and technological resources (human and non-human) on the world market appears to be making "the rich countries more and more independent of the poor, even to the extent of drawing from them their potential developmental leadership" (Boulding, 1968: 118-119; and Myrdal, 1956: 323ff). Scientific training in American colleges and universities is geared to the level of development of American science and technology; within this environment, few, if any, provisions are made to accommodate the visiting foreign scientist as an agent in development. The visitor, like the immigrant scientist, moves in a world market which operates independent of conscious designs for development.

Grubel's second point is simply not true. There are innumerable obstacles to the free flow of scientific information and personnel, including restrictions on the movement of scientific instruments across national boundaries, passport and visa requirements, and barriers to the free movement of research vessels or scientific groups across politically defined boundaries (Revelle, 1963: 126; Rose and Rose, 1970: 180-181). The role of the visiting scientist and the function of scientific exchange programs is not independent of national policy considerations defined in terms of "national interest"; the political economy of international science does not permit the operation of a laissez faire system of scientific exchange.

Concerning the third point Grubel makes, where there is an actual brain drain (through migration) the scientist does indeed take along his "claim on the nation's output" but he also takes with him a potential for contributing to the knowledge-based inputs specific to the needs of his society. Where the scientist is trained in the United States but returns home, there is another type of "drain" to the extent that the returnee's training did not prepare him technically, professionally, or axiologically for confronting the developmental problems of his home country, and the related opportunity structure for the skills and values he has learned and internalized as a professional scientist (Cf. Deutsch, 1970: 181).

The work experiences of the visiting foreign scientist obstruct the development of his potential to actively contribute to industrial and socio-political changes in developed as well as developing countries. The emphasis of international education and exchange programs on students as opposed to faculty, and on internationalizing the American curriculum as opposed to carrying on technical-assistance programs is one manifestation of the low priority accorded education for international and world development by the United States (Deutsch, 1970: 181). This is further illustrated by the low, almost negligible proportion of scientists visiting or on exchange from "third-world" nations (Tables 9, 10: 48-50). The high proportion of visitors from England, Germany, and Japan reflects the economics of exchange as well as the operation of market-like pulls and pushes in science. Even among undergraduates visiting from abroad, approximately one-third of those from countries prepresented by more than 1000 foreign students in recent years have been from developed countries; in 1967-68, about one-sixth of such students were from Canada (IIE, 1967-68).

That development is not a salient feature of exchange or visiting scientist programs is also evident in the tendency to evaluate such programs in terms of their impact on the individual participants. This tendency is reflected not only in the design of such programs by private and public agencies, but also in the research literature. The most recent example of the latter is the study of an exchange program for broadcasters by Kelman and Ezekiel, Cross-National Encounters (1970): the book is sub-titled "The Personal Impact of an Exchange Program for Broadcasters."

The implications of a possible reversal of the "brain drain" to the United States are not usually considered in terms of world development; rather, a balance of payments, national-interest orientation prevails. In an article on "brain drain" reversal, Thomas P. Southwick (1970: 566), noting that many foreign-born scientists are leaving the United States and probably will not return, writes:

> If this trend represents simply a leveling off of an unnatural imbalance of scientists, which came about in the mid-1960's, Congress may find that there is no cause for alarm. But, if it finds that the trend indicates a significant loss of scientific manpower for the United States, Congress indeed will have cause for concern.

The concern of the Congress will have little to do with manpower needs in a global perspective. Brain drain flows, exchange programs, and structures to accommodate visiting scientists are dependent on priorities and opportunities in universities, and federal monetary allocations. These conditions manifest the lack of control men have over distributing themselves in accordance with global needs.

Our respondents work in a milieu which assigns a low priority to "production objectives," and emphasizes specialization (Brown and Harbison, 1957: 84, 87). Visitors from the developing countries receive training in a work environment oriented to professional norms and "fundamental research" when scarce capital "in relation to the most insistent needs of economic and social development almost forbids any fundamental research which requires expensive equipment or considerable numbers of expensively trained persons" (Shils, 1961: 219).

The significance of all this for visitors from developed countries, already pointed out earlier in this chapter, is underscored by the fact that it is now reasonable to challenge the hitherto taken-for-granted conceptions of significance of basic research for national and world development, and for the emergence of a world-wide "culture" (e.g., Allen, 1970; Brown, 1970).

The critique of "basic science" cannot, it must be emphasized, be simply and naively negative. Individuals capable of contributing to theory in science are a necessary ingredient for national development (Cf. Stone, 1969: 1118). But it is impossible to rely any longer on a ritualistic commitment to ideas of purity in science and in science as the foundation of "progress." The problem of manpower is not a simple matter of training for basic or applied science; the problem is to match manpower needs and manpower training to the conscious design of national and world development, or more generally, social change. Third-cultural milieu in the United States cannot be expected to clearly and unequivocally facilitate cooperation among nations, national and world development, and the building of a world community within the context of present conceptions of national interest and priorities. In evaluating the prospects for national and world development, world-wide cooperation, and the emergence of some form of world society, we cannot ignore the crucial role of the United States given the immense quantity of resources it has access to and controls.

Concluding Notes

I have not used the term "training" in discussing the visiting foreign scientist's role inadvertently. While university officials and scientists may be more concerned with conducting efficient research than with "training" foreign scientists (NAS, 1969: 206), our respondents see their visit to the United States as a means for learning and/or improving their research skills (Table 30; see also

TABLE 30

DISTRIBUTION OF RESPONDENTS BY PURPOSE OF VISIT TO A UNITED STATES UNIVERSITY

Purpose of Visit	Respondents N	Respondents %	IQV %
To learn and/or improve research skills	143	64.5	
To teach	2	0.9	
Other (including both of the above)	77	34.6	
Total	222	100.0	70.0

NAS, 1969: 207). Whatever the relative emphasis in the work situation, "research efficiency" and "training" take precedence over "education" in Boulding's sense (1968: 113), i.e., improving the capacity to learn. The NAS study I have been citing concludes (as I have) that the visiting foreign scientist experience is not designed to promot national development in "countries of origin" (NAS, 1969: 217). But how are we to interpret their conclusion that the emphasis is instead on "individual development," especially in light of the low priority accorded "education?" This is an equivocal contention at best, not only in terms of the arguments I have developed in this chapter, but in terms of the NAS data itself. Indeed, the report raises the spectre of "exploitation," and quotes one university dean who suspects

> . . . that the particular mix between foreign postdoctorals and citizens of the United States depends upon the drawing power of a particular professor. He will normally pick the most promising men applying to work with him, although he may be influenced somewhat by his desire to be known and have influence in particular foreign countries. Some of the so-called foreign postdoctorals are simply hired hands and reflect the fact that some foreigners, often with not too great ability, are willing to do kinds of work which American postdoctorals or graduate students will not do (NAS, 1969: 208).

An extreme example of the "hired hand" situation is the case of a 39 year-old ecologist I interviewed. He has <u>no</u> college degrees (though he has studied at the university level), and no publications; but he has spent more than seventeen years studying plant and animal populations, some of this work carried out using radioisotope techniques. In his words,

> Without grades and without a degree, I am nothing. Seventeen years of experience, but I am still considered a graduate assistant.

> The work I am doing is as advanced as anything the Ph.D.s here are doing. But my supervisor will publish _my_ work under _his_ name.

The NAS report (1969: 219) notes further that

> . . . there has been little effort made to adapt the postdoctoral experience to the home country's needs. This lack of effort results, in part, from the means of support. The research that the faculty member is doing and in which the postdoctoral participates is performed in response to American national needs. Federal agencies support research that is appropriate to the stage of development of this country; if it is appropriate for another country, that circumstance is accidental.

The relevance of the "means of support" argument for our respondents is in part established by noting the sources of support for travel and research among our interviewees. Of the thirty-three visitors who received funds to travel to the United States, nine (27.3%) were receipients of United States government assistance; eleven (33.4%) received financial support from their host university or from a private American foundation (Table 31). Their research activities in the United States were supported primarily by Federal funds (43.5%) or university grants (42.4%); these were usually "principle investigator" grants to American scientists, laboratories, or programs (Table 32).

There is some indication in the NAS study (1969: 219) that "as one moves from physics through chemistry to the biosciences the degree of relevance increases for those postdoctorals from less developed countries. In all fields

TABLE 31

DISTRIBUTION OF INTERVIEWEES BY SOURCE OF FINANCIAL SUPPORT FOR THEIR TRIP TO THE UNITED STATES

	Country Providing Support					
	Home Country		U.S.		Other	
Source	N	%	N	%	N	%
Government	8	24.2	9	27.3	1	3.0
Industry	3	9.1	0	--	0	--
Foundation	0	--	6	18.2	0	--
University	1	3.0	5	15.2	0	--
Total[b]	12	36.3	20	60.7	1	3.0[a]

[a]Row total: % = 100.0; N = 33.

[b]Personal resources: 43 (52.5% of total sample--N = 82); "Other" sources: 3 (3.7% of total sample--N = 82).

TABLE 32

DISTRIBUTION OF INTERVIEWEES BY SOURCE OF FINANCIAL SUPPORT FOR THEIR RESEARCH ACTIVITIES IN THE UNITED STATES

	Respondents	
Source of Support	N	%
Host university	33	42.5
U.S. government	34	43.5
Home country	1	1.3
Other	9	11.5
Don't know	1	1.3
Total	78[a]	100.0

[a]N = 82. Number of "no answer" = 4.

the training is more relevant for highly developed countries, i.e., countries more like the United States." This conclusion is based on faculty mentors' opinions of the postdoctoral experience; while they may not be "the best evaluations on this subject" (NAS, 1969: 219), these data conform to expectations based on my analysis. I would caution that in evaluating relevance for the needs of home countries, faculty mentors may have assumed the relevance of their "advanced basic research" for developed countries, an assumption which may be, as noted earlier, untenable.

In the following chapter, the issues discussed above are explored in a related but somewhat different perspective based on an interpretation of the norms of science as elements in an ideology of science.

CHAPTER III

THE IDEOLOGICAL FUNCTION OF THE NORMS OF SCIENCE

My objectives in this section are to (1) explore the meaning of idology in science, (2) examine on a general level the consequences of professionalization and bureaucratization in science, especially for ideology-formation, and (3) interpret the visiting foreign scientist experience as a manifestation of ideology-formation in science. The serendipitous provocation for this undertaking stems from an originally peripheral inquiry concerning the "norms of science."

The Norms of Science

Norman Storer (1966: 78-80), proceeding from the contributions of Robert K. Merton and Bernard Barber, identifies three orientational and three directive "norms of science":

1. Universalism (orientational)--". . . physical laws are everywhere the same and . . . the truth and value of a scientific statement is independent of the characteristics of its author."

2. Organized scepticism (directive)--". . . each scientist should be held individually responsible for making sure that previous research by others on which he bases his work is valid. . . .

"The scientist is obligated also by this norm to make public his criticisms of the work of others when he believes it to be in error. . . .

". . . no scientist's contribution to knowledge can be accepted without careful scrutiny, and . . . the scientist must doubt his own findings as well as those of others. He must hold himself entirely responsible for the goodness of his work."

3. Communism, or communality (directive)--"[The scientist should] share his findings with other scientists freely and without favor, for knowledge that is not in the public domain cannot be part of the legitimate body of knowledge against which creativity is measured and to which other scientists refer in their work . . . this norm encourages the scientist to take the initiative in placing his findings before his fellow scientists."

4. Disinterestedness (orientational)--"It is illicit for the scientist to profit personally in any way from his research. . . . In general, it serves to encourage 'science for science's sake' or to make research and discovery an end in itself."

5. Rationality (orientational)--". . . a faith in the moral virtue of reason"; the goals of science are pursued according to "empirical test rather than tradition and . . . a critical approach to all empirical phenomena rather than acceptance of certain phenomena as exempt from scrutiny and . . . the necessity of maintaining a common set of standards by which proof may be demonstrated."

6. Emotional neutrality (directive)--". . . avoid so much emotional involvement in . . . work that . . . a new approach [cannot be adopted or an old answer rejected] when . . . findings suggest that this is necessary, or that findings are distorted in order to support a particular hypothesis."

Storer's conception of the function of these norms (1966: 86) illustrates their place in the sociology of science:

> . . . scientists support the norms of science, through their own allegiance to them and through imposing sanctions on those who violate them, because they are in some sense aware that these norms are necessary if the exchange-system of science is to operate properly. Because each scientist, to the extent that he wishes personally to be creative, is interested in maintaining a social structure in which his efforts can continue to receive honest, competent response from others, he has a personal stake in supporting the norms that make this possible.

But this is not a sufficient introduction if we wish to understand what the "norms of science" are as a sociological construct. When originally formulated by Merton (1957: 551-561), universalism, communism, disinterestedness, and organized scepticism were elements of an "ethos" of science, an ". . . affectively toned complex of values and norms which is held to be binding on the man of science." These norms-values were also defined as "institutional imperatives," a term Merton used synonomously with "mores" (1957: 552); these "imperatives," or "mores," are "binding, not only because they are procedurally efficient, but because they are believed right and good. They are moral as well as technical prescriptions" (1957: 553).

Bernard Barber (1952: 122-134), viewing science as a "moral enterprise," identified a set of "moral values" common to science and to the "'ideal type' of liberal society": rationality, emotional neutrality, universalism, and individualism. In addition, Barber described the "moral ideals" of science: these are "somewaht different from the dominant patterns of liberal society as they exist today, although these ideals are important in some other areas than science proper and could even some day become the dominant moral values for the whole society": communality (a politically and ideologically "clean" rendition of Merton's "communism"), and disinterestedness, or other-orientation (following Parsons, 1949: Chapter VIII).

In the third major contribution to this field, Parsons (1951) uncovered three levels of "norms" (Kaplan, 1964: 855-856): (1) "technical" norms--empirical validity, logical clarity, logical consistency, and generality of principles (Parsons, 1951: 335); (2) the set of pattern variables associated with the occupational role of the scientist--universalism, affective neutrality, specificity, achievement orientation, and collectivity orientation (1951: 343; Cf. Merton's imperatives); and (3) research norms--tentativeness, and "an obligation . . . to accept the validity of scientific findings and theories which have been adequately demonstrated" (1951: 353; Cf. Merton's imperatives).

Two problems are associated with these attempts to identify normative-evaluative orientations in science: one was noted in Norman Kaplan's excellent review article for the Handbook of Modern Sociology (1964: 857): "Whether their analysis is correct or not, the point to be stressed here is that the values posited by Merton and Barber and Parsons have been fully accepted as those which prevail today, without any additional empirical verification or theoretical analysis." It is interesting to note that Kaplan chose the term "values" even though he consistently used the term "norms" in discussing the contributions of Merton, Barber, and Parsons; and this is the second problem: are these overlapping concepts in the works of Merton, Barber, Parsons, and Storer "norms," or "values," or "moral ideals," "institutional imperatives," or "mores?" I will examine this problem first.

Storer is the least ambiguous among the sociologists of science in defining "norms of science" as distinct from "values of science." The distinguishing "rule-of-thumb" is that ". . . values concern primarily end-states or the characteristics of desirable goals, whereas norms pertain more to standards of behavior without direct regard for the purposes of that behavior"; the norms define "the sorts of behavior in which scientists should engage, rather than the goals they should seek" (Storer, 1966: 76-77). In spite of this prelude, Storer cannot resist the temptation to introduce the six orientations and directives as ". . . norms (values) . . ." (1966: 77). Blake and Davis (1964: 456-457) employ the term "norm" "to designate any standard or rule that states what human beings should or should not think, say, or do under given circumstances." In this sense, they note, the salient factor is "should," "for it clearly implies two important propositions: first, that actual behavior <u>may</u> differ from the norm; second, that it <u>will</u> differ from the norm unless some effort or force is exerted to bring about conformity." Furthermore, "disembodied values--i.e., values without norms through which they can be collectively achieved--are like purely private norms sociologically irrelevant." Finally, "The sociological use of the term generally assumes, without always saying so, that norms are shared to some extent." Certainly, a norm may be more complex than a simple "shared should statement" (Cf., Blake and Davis, 1964: 464-465; Williams, 1968; Gibbs, 1968); but it is at least that. In order to determine the significance of the norms of science as "shared should statements" some manner of "systematic classification and quantitative analysis" is necessary; without that "we have . . . only the investigator's intuitive assessment of the norms in a social unit" (Gibbs, 1968: 210). Intuition has maintained undue primacy over theory and empirical study in the search for "norms of science"; if it is "shared should statements" we are looking for, there is little reason to suppose that is what the norms outlined by Storer represent. This leads us to the second problem, the theoretical and empirical foundations for the norms.

There is some recognition among sociologists of science of the narrow, intuitive basis for Merton's influential conceptualization of the norms of science. Kaplan (1964: 855), for example, notes Merton's admission that the institutional imperatives "were derived largely from the writings and documents of the seventeenth century." And Storer (1966: 77) is even more explicit in writing that Merton "was able to conceptualize the norms of science, working presumably in part through intuition and testing his ideas against what scientists have said since the seventeenth century about their work and about how scientists should behave." Merton's intuition was more likely an internalization of the speculations (at least from the time of Francis Bacon) and select autobiographical sketches which were the foundation of an idealized conception of science and scientists before anything approaching a systematic sociology of science had emerged. By the time that happened, the idealization seems to have become so salient that it took precedence over empirical research as a stimulus for ideas about, for example and especially, norms in science. The norms of science appear as an abstraction from an idealized abstraction!

To imply that there are identifiable norms of science suggests that science as a social system has been clearly delineated and that the norms are operative among the members of that system. But what is the social system of science? Among what groups or collectivities are the norms operative; is it all persons who define themselves as scientists, at all times in all places? Kaplan points out, for example, that "Implicit in Merton's formulation of his four institutional imperatives is the idea that these have remained relatively unchanged from the time of their early origins" (1964: 855).[28] Are the norms relevant for all living Ph.D.s in science; or for an elite? What is the intensity associated with each of the norms: does the sense of "should-ness" vary in intensity among scientists and for different norms? Is a norm of science a norm if scientists "manifest no sign of true commitment to [their] normative opinions?" (Gibbs, 1968: 210). And to what extent is "any departure of real behavior from the norm [followed] by some punishment?" (Homans, 1950: 121). What, in short, do the norms of science tell us about the world's working scientists?

My research suggested to me the idea that the norms, whatever their origin, are today part of an ideology among scientists that has emerged concomitantly with the professionalization and bureaucratization of scientific activities. The norms appear to function as a set of ideas about science which explain and justify scientific activity. I intend to pursue this argument with reference to "disinterestedness" because (1) this was the primary focus of my data on norms, and (2) in a sense, it is the most general, and therefore the most representative of the norms, and the most critical. The traditional conceptions of basic or pure science, of the right to autonomy in scientific activity, the idea of knowledge for its own sake, have emerged as ideas which explain and justify autonomy and basic science independent of a studied investigation of science as a social system. Scientists who are engaged in basic research do not so much behave in accordance with the norms, or orient themselves to the norms, as they use the norms to explain and justify their right to be left alone, to pursue their own problems in their own way, without societal interference and without concern for societal needs and problems.

Science and Ideology

Shils (1968: 73-74) argues that the sciences cannot be considered an ideology for the reason that they are "genuinely intellectual pursuits, which have their own rules of observation and judgment and are open to criticism and revision. . . .":

> Although scientific activities and outlooks--in terms of both procedure and substance--are parts of a general culture or a prevailing outlook, they are very loosely integrated parts of those cultures or outlooks (just as the various parts of science are not completely integrated with each other). . . . it is characteristic of prevailing outlooks to be loosel- integrated internally and to have no single element that predominates exclusively over the others. . . . In a great variety of ways, the scientific and the nonscientific parts of prevailing outlooks, creeds, and movements of thought influence each other, and at the same time, each part possesses considerable autonomy. It is likely that this relationship will become more intense in the future and scientific knowledge, although never becoming exclusively dominant, will have an even greater influence on prevailing outlooks, creeds, and movements of thought than it has had. For all these reasons, assertions to the effect that "science is an ideology" or that "the social sciences are as ideological as the ideologies they criticize" must be rejected.

David Apter (1965: 343), however, identifies science as one form of ideological thought; the second form is dogma. Apter argues that "the ideology of science involves high information and practical realism":

> The ideology of science is not merely a style of thinking about problems, nor is it solely a derivation from the functional significance of science in an industrialized world, although this is clearly the origin of its power. Rather, it is the application of rational methods and experimentation to social affairs.

The characteristics of science as an ideology are, according to Apter, "(1) science is a well-defined ideology possessing norms of empiricism, predictability, and rationality as guides to conduct, (2) social science is becoming accepted as scientific, and scientific norms are increasingly accepted as guides to social conduct, (3) there is a universal trend toward planning, calculations, and rationalistic goals concerned with the future in both the developing and the developed areas, (4) in the developing areas, vulgar ideologies adopt the values of science through some form of socialism in association with the national independence movement . . ., (5) in the industrial countries, the new ideology expresses itself in a meritocracy" (Apter, 1965: 343).

Why these characteristics are defined as aspects of an ideology when they appear to be nothing more than a reiteration of the normative-evaluative system posited for science derives from Apter's conception of ideology: ideology "links particular actions and mundane practices with a wider set of meanings, giving social conduct a more honorable dignified complexion. . . . From another viewpoint ideology is a cloak for shabby motives and appearances. . . ." (Apter, 1965: 314). But in distinguishing science from dogma, Apter (like Shils) neglects the fact that science is a social process; and professionalization and bureaucratization, for example, can introduce a rigidity into science which is accompanied by a "dogmatization" of ideas in science. The pervasive notion that of all human endeavors only science is cumulative and progressive obscures the simple observation that science is a social activity subject, like all social activities, to changes in structure and idea-systems. Apter's conception of science as an ideology, paradoxically, appears to include the seeds of a form of change in science toward dogma: point four above (page 121) seems to entail a potential for something akin to the scientistic metamorphosis of science in twentieth century China (Kwok, 1965).

If science is not to be distinguished from dogma (since scientific activity can be dogmatized), what then is the relationship between science and ideology? It is useful to begin by recalling Mannheim's conception of ideology:

> The particular conception of ideology is implied when the term denotes that we are skeptical of the ideas and representations advanced by our opponent. They are regarded

> as more or less conscious disguises of the real nature of a situation, the true recognition of which would not be in accord with his interests.
>
> The more inclusive total conception of ideology . . . [refers] to the ideology of an age or a concrete historico-social group, e.g., of a class, when we are concerned with the characteristics and composition of the total structure of the mind of this epoch or of this group. The ideas expressed by the subject are . . . regarded as functions of his existence. This means that opinions, statements, propositions, and systems of ideas are not taken at their face value but are interpreted in the light of the life-situation of the one who expresses them. It signifies further that the specific character and life-situation of the subject influence his opinions, perceptions, and interpretations (Mannheim, 1936: 55-56).

Mannheim goes on to exchew the term "ideology" because of its moral connotation, and speaks instead of the "perspective" of a thinker, "the subject's whole mode of conceiving things as determined by his historical and social setting" (1936: 266). Even though Mannheim affirms the applicability of the particular conception of ideology "for certain aspects of the struggles of everyday life" (1936: 77n), his tendency to emphasize the moral connotation of "ideology" and to discuss the underlying assumptions of the sociology of knowledge as a "total conception of ideology" detracts from the sociological utility of ideology in what he refers to as its particular sense.

Ideology, in the usage I intend, entails "explanation and justification" (Blumer, 1955: 210; Bendix, 1956: 2n). I should like to follow Hodges' recent summary of "the substance of ideology" (1971: 354-355) in arriving at a working definition, with the following proviso: my intention is to conceive ideology as a general sociological concept applicable to general sociological phenomena and not mainly or exclusively to political and/or economic institutions. The central features of ideology are:

1. Argument: "ideologies are meant to persuade and to counter opposing views."

2. Utopian goals defined in "unrealistically optimistic terms" (Watkins, 1964: 7).

3. Program "for the defense or reform or abolition" of societal value systems and institutions."

4. Rationalization: here I should like to substitute "always" for "very frequently" in affirming Berger's statement that "ideologies systematically distort social reality in order to come out where it is functional for them to do so" (1964: 111). Rationalization may be more or less conscious, more or less salient, more or less elaborate, but is always present in some degree (by definition) wherein we speak of ideology.

5. Over-simplification: "Anyone who believes that his goals are absolutely and overwhelmingly in the public interest will suspect something sinister about the motives of those who reject his conclusions" (Watkins, 1964: 8); a proneness "to think in . . . terms of we and they, friend and enemy."

6. Reference group: an individual's ideologies are associated with groups he identifies with. The implication here is the self-evident one that ideologies are phenomena of social groups. They are at once cause and consequence of conceiving one's own group as an "in-group," and all other groups as "out-groups."

7. Sacred documents: e.g., "manifestos, declarations."

8. Heroes: "founding fathers, seers and sages, courageous leaders, martyrs."

9. World-view: "Ideologies represent theories of fundamental causes and effects; they portray a 'valid' view of the world and the nature of man."

10. Affectivity: Hodges argues that "Ideologies are emotional and affect-laden; they are ultimately premised on action." He has in mind, and quotes, Bell's statement (1961: 395) that "What gives ideology its force is its passion. . . . For the ideologue, truth arises in action, and meaning is given to experience by the 'transforming moment.' He comes alive not in contemplation, but in 'deed.'" It might, however, be more useful in trying to generalize the concept ideology to conceive the action-premise somewhat differently. The affective component of ideology can be viewed as the basis of an action-potential which can be activated in different ways, to different degrees (and with varying probability) at the individual

and the group level. This action-potential may be manifested, for example, in "defense mechanisms"; it might emerge in a physical act (e.g., the hat-pinning of a protestor by a biologist's wife at the 1970 meetings of the American Association for the Advancement of Science); and it might be activated in a class-type struggle.

With this working-definition in mind, we can return to a consideration of the views expressed by Shils and Apter. In opposing the ideas of ideology and dogma, respectively, to science, Shils and Apter (like Merton and other students of science) have in mind an idealized conception of science and scientists. The fact that there is no substantive referent for this conception in the activities of scientists is of special significance given the societal role of the scientist defined in the perspectives of Shils and Apter. For Shils, the scientific community is a microcosm of a world community. Apter views scientists as central actors in the period of "practical realism" during the modernizing process of ideology formation. But in both cases we are given the strong impression that science emerged, developed, and settled into some form of dynamic equilibrium characterized by continuity in values, goals, and progressive growth. But the institutionalization of scientific activity beginning in sixteenth century Western Europe made possible not only the relatively autonomous development of science but carried with it the potential for the emergence and development of an ideology. Even the recognition of that potential, let alone its analysis, has been obstructed by the failure to view science processually, changing in response to socio-cultural conditions as well as its own "internal" dialectic.

To conceive an "ideology of science" implies dogmatization in support of science as a style of life, and the collective cultivation of a "false consciousness" (which, following Mannheim, can take "the form of an incorrect interpretation of one's own self and one's role" (1936: 96)) which conceals from scientists the socio-cultural foundations of their role and the social consequences of their daily activities. My research suggests that the norms of science are part of the ideology of science; the norms have been incorporated into a system for defining, maintaining, and defending the boundaries of science and the perquisites of the scientific role.[29]

Disinterestedness as Ideology

"Science for its own sake," or disinterestedness, is, in a sense, the core of the norms of science. The significance of disinterestedness is that the norms are rooted in the idea of a "basic" or "pure" science. It is this norm that underlies our respondents' overwhelming commitment to basic science (Tables 16, 18, 19, and 20: pp. 63-68). This

commitment is continuous with their pre-U.S. experience: more than half of our respondents described their research abroad (i.e., in their home country) as "basic." Other manifestations of this commitment, or orientation, are (1) the high proportion of respondents whose work is "definitely" or "somewhat" characterized by theory construction, and the small proportion whose work is characterized as "definitely" or "somewhat" clinical, or technological (Table 13: 57). The manifestation of disinterestedness is not, however consistent. For example, 98 (73.7%) of the 133 scientists who answered the questionnaire item, "How important are the problems facing mankind in determining your choice of a research problem" indicated "very" or "somewhat" important; 95 (72.0%) of 132 respond-
73%
ents noted that problems facing their home countries were important; but approximately two and one-half times as many rated "scientific considerations" very important as rated "problems facing mankind" and "home country problems" very important (Table 19: 67). Thus, while some rated all three items very important, the high proportion rating scientific considerations very important can be interpreted as a manifestation of the force of the norm disinterestedness. The force of the norm can also be interpreted as the explanation for the distribution of responses in the "not at all" category; about one-quarter of the scientists indicated that problems of mankind and of home country are not at all

important in determining their research choices, but only about four percent said that scientific considerations were not at all important. There is, even so, a substantial non-normative pattern; this pattern is further reflected in answers to questions on determinants of job location choices (Table 33). Nearly 70 percent of respondents to our questionnaire rated the opinions of their wives and/or children ("family opinion") as "very" or "somewhat" important determinants of such choices. Salary and country are also considered important. Here too, though, disinterestedness appears to be operative: nearly 90 percent rated "quality of facilities" and "quality of scientists" as important determinants of job location choices.

It appears, then, that my data to some extent manifests the operation of disinterestedness. There is, however, considerable deviation from the norm: our respondents give evidence of being oriented to and directed by norms other than "science for its own sake." There is, in addition, a further reflection of deviation from this norm in our respondents' expressed sense of social responsibility for the possible social consequences of their research (Table 34). But the questions which elicited the responses I have been discussing were generally "abstract" and "impersonal." Disinterestedness is much more in evidence when respondents discuss their present research activities. And it is this that provides the clue concerning the function

TABLE 33

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY IMPORTANCE OF SCIENCE FACILITIES, SCIENTISTS, COUNTRY, FAMILY, AND SALARY IN DETERMINING THEIR CHOICE OF WORK LOCATIONS

	Determining Factors									
	Quality of Science Facilities		Quality of Scientists		Country		Opinion		Salary	
Rated Importance	N	%	N	%	N	%	N	%	N	%
Very important	92	67.5	75	56.8	55	40.7	38	31.4	27	20.2
Somewhat important	29	21.4	41	31.1	54	40.0	43	35.6	80	59.6
Hardly important	8	5.9	11	8.3	14	10.4	19	15.7	15	11.2
Not important	7	5.2	5	3.8	12	8.9	21	17.3	12	9.0
Total[a]	136	100.0	132	100.0	135	100.0	121	100.0	134	100.0
IQV(%)[b]	28.8		33.0		49.5		74.7		51.5	

[a]N = 140. Several respondents failed to respond on each item.

[b]Based on collapsing "very" and "somewhat" important categories; Mean IQV = 47.5.

TABLE 34

DISTRIBUTION OF RESPONDENTS BY EXPRESSED SENSE OF SOCIAL RESPONSIBILITY FOR THE POSSIBLE SOCIAL CONSEQUENCES OF THEIR RESEARCH

Expressed Sense of Social Responsibility	Respondents		IQV
	N	%	%
Definitely	125	58.4	
Somewhat	65	30.4	
Not at all	24	11.2	
Total	214[a]	100.0	83.0

[a]N = 222. Number of "no response" = 8.

of the norm disinterestedness. In defining themselves as "basic scientists," our respondents effectively negate their expressed sense of social responsibility as scientists. Many of our interviewees expressed a sense of social responsibility; but when asked about how this was reflected in their actual research activities, they responded that they were engaged in "basic research," and therefore social responsibility was either (1) inherent in what they were doing, or (2) irrelevant because there was no way to predict the consequences of their work. A thirty-three year old postdoctoral social scientists, for example, (illustrating the coincidence between the views of the several social scientists in our sample and the views of the physical and biological scientists who made up the bulk of respondents) said simply that he "believed in the efficacy of well-done social research"' he believed, he said, in the "goodness of basic research." Among the minority of scientists who were conscious of a direct connection between their sense of social responsibility and their ongoing research was a thirty-five year old biochemist who said he used to "synthesize compounds which no one else had just for that reason." Now, however, he has a "better feeling"' he feels he has recognized and is oriented to the relationship between enzyme reactions in tissue and the prevention or improvement and curing of illnesses. An interesting and unique response was offered by an advanced Ph.D. candidate in the same field, enzymology. He was certain his work, and work in the field generally, would have a "great influence" on society; but neither he, nor any other individual scientist is responsible for this influence--"Every scientists works on a particular problem which leads to one collective principle which is their influence." The important qualification he offered was that the "<u>great</u> scientist <u>is</u> responsible."

While nearly 60 percent of our questionnaire respondents felt a "definite" sense of social responsibility, and about 30 percent felt "somewhat" responsible, only 6 percent felt their research might have an adverse effect on mankind (Table 35). In their perspective (judging from discussions

TABLE 35

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY ANTICIPATED CONSEQUENCES FOR MANKIND OF THEIR PRESENT RESEARCH

Anticipated Consequences of Present Research for Mankind	Respondents N	Respondents %	IQV %
Will be of great benefit	64	48.9	
Will have an adverse effect	8	6.1	
Will have no foreseeable effect	59	45.0	
Total	131[a]	100.0	83.0

[a]N = 140. Number of "no response" = 9.

with our interviewees on this issue), the basic scientist is by definition socially responsible. The pervasive faith in basic science characteristic of our respondents is suggested by responses among our interviewees to two additional questions: more than three-quarters of these scientists believe that scientists are important for achieving the ideal future they foresee for their home country (Table 36); and 70.0 percent feel that the ideal future they foresee will be achieved (Table 37). Their optimism about developments in their home country, as well as in the world during the next ten years or so (Table 38), suggests that they have internalized science as an ideology--basic research is good in and of itself, and contributes to the development of mankind. Such an interpretation is consistent with features

TABLE 36

DISTRIBUTION OF INTERVIEWEES BY PERCEIVED IMPORTANCE OF SCIENTISTS IN THEIR HOME COUNTRIES FUTURE DEVELOPMENT

Rated Importance of Scientists	Respondents N	Respondents %	IQV %
Important	65	82.5	
Not important	9	11.4	
Other	5	6.2	
Total	79[a]	100.0	46.0

[a]N = 82. Number of "no answer" = 3.

TABLE 37

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THEY ARE OPTIMISTIC ABOUT THE DEVELOPMENT OF THEIR HOME COUNTRIES DURING THE NEXT DECADE

Expressed Optimism	Respondents N	Respondents %	IQV %
Yes	49	70.0	
No	12	17.2	
Don't know	9	12.8	
Total	70[a]	100.0	70.0

[a]N = 82. Number of "no answer" = 12.

TABLE 38

DISTRIBUTION OF INTERVIEWEES BY WHETHER THEY ARE OPTIMISTIC OR PESSIMISTIC ABOUT THE WORLD'S FUTURE DURING THE NEXT DECADE

	Respondents		IQV
Responses	N	%	%
Optimistic	53	68.0	
Pessimistic	12	15.4	
Both optimistic and pessimistic	8	10.2	
Uncertain	5	6.4	
Total	78[a]	100.0	66.6

[a]N = 82. Number of "no answer" = 4.

(2) utopian goals and (9) world-view, in the working definition of ideology outlined on pages 124-125. This takes us beyond questions of "disinterestedness" and the norms of science as ideology to questions of science as ideology; questions I will take up shortly.

To define one's research as "basic" explains and justifies what amounts to an obligation to eschew responsibility as a scientist for the present and future social consequences of one's scientific work. Why is the disinterested pursuit of science "ideology"? For the idea that science is to be pursued independent of all extra-scientific considerations to be defensible, it must be possible to show that science is an autonomous, self-correcting process which develops or progresses according to its own internal rules and laws. But the fundamental contribution of the sociology of science has been to bring into the field of systematic inquiry ("scientific analysis," if you like) (1) the impact of science on society, and (2) the impact of society on science. Admittedly, the emphasis in the sociology of science has been on the former; the manner in which society affects ideas and directions in science continues to be virtually ignored, more than a decade after Merton noted the "uneven attention" accorded this aspect of the "dynamic interdependence between science, as an ongoing social activity giving rise to cultural and civilizational products, and the environing social structure" (1957: 531). Nevertheless, the perspective has been established and the imperative outlined: at the very least, it is now reasonable to ask that the issue of purity in science be subjected to the same forms of inquiry scientists are expected to exhibit in their own research. There is a growing recognition among scientists that statements such as the following by a zoologist I interviewed are sociologically naive: "My role as a scientists, insofar as society is concerned, is negligible; what I produce is negligible in its consequences. I have no sense of a responsibility to society in choosing problems." Physicist Charles Schwartz recently issued a reminder to his colleagues that ". . . in order to decide whether some given organization is in fact free, pure, and disconnected from the troubles of the world is a matter for objective evaluation, not wish fulfillment. . . ." (in Brown, 1971: 25-26). In evaluating commitments to basic science, some scientists concerned with social responsibility have drawn attention to such facts as the scarce fifty years that separate Becquerel's discovery of radioactivity (1896) and Hiroshima (e.g., Shapiro, et al., in Brown, 1971: viii). Commoner (in Brown, 1970: 178) commenting on how narrow the gap between basic discovery and scientific application has become, writes, "Scientists can no longer evade the social, political, economic, and moral consequences of what they do in the laboratory."[30]

Marcuse has noted (1969: 477) that, "The scientist remains responsible as a scientist because the social development and application of science determine, to a considerable extent, the further conceptual development of science. The theoretical development of science is thus in a specific political direction, and the notion of theoretical purity is thereby invalidated." The emergence of science as an autonomous, functionally differentiated social activity beginning in sixteenth century Europe, and the emergence of the scientific role, were preconditions for the cumulative, progressive characteristics of modern science (e.g., Karp and Restivo: 1971). The functional differentiation of science "was destructive of medieval dogmatism and superstition, it was destructive of the holy alliance between philosophy and irrational authority, it was destructive of the theological justification of inequality and exploitation" (Marcuse, 1969: 478). But the very institutionalization of scientific activity which made the "self-correcting" ideal something of a reality eventually placed science in a competitive relationship with other more or less autonomous institutions for scarce resources. This competitive relationship, and the growing demand for resources in science, has promoted the creation of a set of ideas which explain and justify the scientist's demands on society's reservoir of resources. The individual scientist must explain and justify why he should be accorded certain privileges and provided with access to the resources he requires for his research. Under the set of conditions surrounding the emergence of modern science it may be that the self-correcting, rational, tentative, and open model of science had some meaning; but even then, the operation of the norm disinterestedness, for example, could not be taken for granted, as Merton illustrates in his critique of G. N. Clark's conception of the significance of disinterestedness in seventeenth century English science (Merton, 1957: 607-608).[31] It is naive, under any conditions, to assume that such a model has a high degree of explanatory or descriptive power today. I would like to explore in more detail the two processes I have several times referred to as having had an overwhelming impact on science (especially with reference to the "ideal-type" conception of science), professionalization and bureaucratization.

Professionalization, Bureaucratization, and Ideologicalization in Science

The essential elements of the ideal-type profession, as outlined by Greenwood (1957) are: (1) a basis of systematic theory, (2) authority recognized by the clientele of the professional group, (3) broader community sanction and approval of this authority, (4) a code of ethics regulating relations of professional persons with clients and with colleagues, and (5) a professional culture sustained by formal professional associations. Greenwood conceives occupations to be distributed on a professionalization continuum.

In the process of professionalization, an occupation becomes "relatively colleague-oriented" (Jencks and Reisman, 1967: 201-202): ". . . professionalization means that the practitioners seek the exclusive right to name and judge one another's mistakes." The goals of professionalization are to standardize, "objectivize" (i.e., limit the impact of subjective elements on performance and service), specialize, collectivize, and give status to occupational roles and service in society. The commitments this entails are illustrated in the following excerpts cited by A. M. Carr-Saunders (1928--in Vollmer and Mills, 1966: 5-7):

1. "The Pharmaceutical Society was designed as a means of raising the qualifications of pharmaceutical chemists and placing between them and unqualified persons a line of demarcation" (1847).

2. ". . . the maintenance of a high standard of professional character and honourable practice" (Royal Institute of British Architects).

3. The second schedule to the standing orders of the Institute of Journalists contains a list "of acts or proceedings" which "may be deemed to be an act of default discreditable to a journalist." The Council has the power to expel or suspend any member proved guilty of any of the offenses described, the first of which is "the supplying of false news or exaggerated reports."

4. "To raise the status of the teaching profession" (National Union of Teachers, 1870).

5. ". . . contribute to the respectability" of veterinary surgeons (Royal College of Veterinary Surgeons, 1844).

6. "It is impossible to ignore the fact that the status of the professional man must be dependent upon the

salary or fees which he receives. Therefore, as the Institute hopes to raise and maintain the status of the chemist, it must take the economic aspect into consideration. . . ." (Proceedings of the Institute of Chemistry, 1919).

Carr-Saunders' conclusion on professionalization in society (in Vollmer and Mills, 1966: 9) was that ". . . taking all in all the growth of professionalism is one of the hopeful features of the time." The problematics of professionalization, however, arise precisely from the tendency toward occupational demarcation, or "closure." This creates a volatile potential for subordinating reason to dogma: ". . . once given its special status, the profession quite naturally forms a perspective of its own, a perspective all the more distorted and narrow by its source in a status answerable to no one but itself" (Friedson, 1970: 370).[32] In his analysis of the medical profession, Friedson (1970: 371) argues that while professional autonomy may have facilitated significant increments in knowledge about disease and treatment, it "seems to have impeded the improvement of the social modes of applying that knowledge." Horowitz (in Reynolds and Reynolds, 1970: 345) affirms this aspect of professionalization:

> . . . professionalization, by virtue of its grim fight for status, ironically permits a kind of irresponsibility with respect to the future of the social world. The professional

> can, by virtue of his professionalism, exempt himself as a scientist from responsibility for the ends to which his scientific findings are put.

The significance of these "dysfunctional" characteristics of professionalization is that they are reinforced by bureaucratization. These two processes are linked at least to the extent that they are concomitant in the modern history of industrializing societies. Professionalization has been associated with "the increasingly specialized division of labor, the explosion of knowledge, and the rising demand for expertise in the management of a highly technical and highly bureaucratized society" (Jencks and Reisman, 1969: 202). This requires some explication.

The literature on professionals and complex organizations has traditionally stressed the conflicts inherent in linking the roles "professional," and "bureaucrat," based on differences between "professions" and "bureaucracies" (e.g., Parsons, 1954: 34-49; Francis and Sonte, 1956: 153-157; Blau and Scott, 1962: 60-63). An important example of this perspective in the sociology of science is Kornhauser's Scientists in Industry--Conflict and Accommodation; the author's study of professionals in bureaucracies is an examination of the "relations between two institutions, not merely between organizations and individuals" (1962: 8). This perspective places an "independent professional" in a "bureaucratic setting" and focuses on the individual's resistance to bureaucratic rules and supervisors, his rejection of bureaucratic standards, and his conditional loyalty to the bureaucracy (Scott, in Vollmer and Mills, 1966). But Scott (in Vollmer and Mills, 1966: 266-267), having committed himself to viewing professions and bureaucracies as "two institutions," and attending to "areas of conflict," notes that "an examination of the naturally occurring phenomena reveals that professions and bureaucracies are becoming more and more alike; that 'bureaucrats' are being 'professionalized' at the same time that 'professionals' are being 'bureaucratized.'" In fact, the change may be more radical.

The dysfunctional aspects of professionalization, for example, dovetail rather impressively with the dysfunctions of bureaucratization; the latter process stimulates and reinforces tendencies in the former process toward occupational closure and dogma with its demands for "reliability of response and strict devotion to regulation":

> . . . devotion to the rules leads to their transformation into absolutes; they are no longer conceived as relative to a given set of purposes. This interferes with ready adaptation under special conditions not clearly envisaged by those who drew up the general rules. Thus, the very elements which conduce toward efficiency in general produce inefficiency in specific instances (Merton, 1957: 200).

It may be that emphases on the "functional" aspects of professions and the "dysfunctional" aspects of bureaucracies have prevented an awareness of the "convergence of dysfunctions." A "simple" convergence (which has received attention) has occurred as professional associations have become bureaucratized, and as the training milieu for professional socialization have become bureaucratized (e.g., the colleges and universities). The links between the bureaucratic professional associations and the bureaucratic professionalizing milieu have created a "complex convergence of dysfunctions" (which has received less attention than the "simple" convergences) which impinges on the individual undergoing professional socialization. The medical profession may very well represent a standard for this "model" (see, for example, Friedson, 1970; and Brewer, in Brown, 1971: 149-162).

In this convergence of dysfunctions, professionalization and bureaucratization tend to generate closure, an ethnocentrism of work, and a decrease in the capacity of individuals to respond to problems in creative and critical ways. Ultimately, the price of professional training and precision becomes the loss of "objectivity itself" (Horowitz, in Reynolds and Reynolds, 1970: 347). Among the highly publicized manifestations of these "tendencies" in the scientific community is the "Velikovsky affair," in which authority, power, and dogma publicly suppressed rational, tentative, and open scientific activity (de Grazia, 1963).[33]

I have taken the reasonable liberty of substituting "science" for "sociology" (indicated by underscoring the substitutions) in the following statement by Horowitz (in Reynolds and Reynolds, 1970) which effectively and concisely crystallizes the perspective developed in the preceding paragraphs:

> Just as we have found that bureaucracy has many "irrational" and dysfunctional features, so too professionalism has been found, by many of the sciences, to be likewise dysfunctional, and in much the same way as any complex organization is something more and something less than rational. (1) Professionalism leads to great stress because of its overstructuring of the field(s) of science--its ritualistic demands for codification gradually slip over into demands for consensus and finally cohesion, having little to do with scientific standards. (2) Professionalization tends to reduce experimentation to a minimum, be setting arbitrary definitions of scientific activities, and by circumscribing the kinds of positions found acceptable. (3) Professionalization sets up a bureaucratic chain of command and, for that very reason, endures the same complex of pains that all other bureaucratic structures undergo. (4) Professionalization is an ideological posture which, insofar as it removes the scientist from the . . . problems he writes of, tends to weaken his stature in the research efforts to the degree that he becomes professionalized.

The present discussion has brought into focus the qualities of professionalization that pervade the (in this case) scientist's style of work and style of life, his ideas and activities. Our respondents' commitment to science as a profession is manifest in their "basic science" orientation, the identification with science and scientists, the lack of involvement in extra-scientific activities, their general optimism, and their faith in science and its impact on society. Additional data relevant to establishing this commitment is present in Tables 39 and 40. Most of our interviewees indicated an unwillingness to consider changing their profession, an index (albeit crude)

TABLE 39

DISTRIBUTION OF INTERVIEWEES BY WILLINGNESS TO CONSIDER CHANGING THEIR PROFESSION

	Respondents		IQV
Responses	N	%	%
Yes	18	22.9	
No	61	77.1	
Total	79[a]	100.0	70.0

[a]N = 82. Number of "no answer" = 3.

of "job satisfaction." And most of our respondents have participated as "producers" in the social system of science." More than 90 percent have published at least one paper; nearly one-third have published at least 11 papers; and nearly one-third have published at least one book (Table 40). Related data are cited in the first section of Chapter 4. As "types" our respondents are more like Horowitz' (in Reynolds and Reynolds, 1970) "mainliners" (professionalists) than they are like "marginals" (occupationalists).[34] Their professionalism is stimulated and reinforced in the host universities. It is within this

TABLE 40

DISTRIBUTION OF RESPONDENTS BY NUMBER AND TYPES OF PUBLICATIONS

Number of Publications	Type of Publication: Journal Articles N	%	Books N	%
None	12	5.9		
1-5	91	44.6		
6-10	34	16.7	(IQV = 88.0)	
11 or more	67	32.8		
Total	204[a]	100.0		
None			78	66.6
1-3			36	30.8
4-6		(IQV = 59.0)	2	1.7
7 or more			1	0.9
Total			117[b]	100.0

[a]N = 222. Number of "no answer" = 18.

[b]N = 222. Number of "no answer" = 5.

professional-bureaucratic system that the "meaning" of the norms of science is rooted.

The norms are operative--they are, to a great extent, "shared" by our respondents. But they are not "simple should statements"; nor are they simply implicated in a system of conflicting norms which generate "ambivalence" (Merton, 1963).[35] They are a source of explanation and justification--of argument, world-view, rationalization--reflecting and consistent with the professional-bureaucratic organization of scientific activities.

There is, in some of the most recent literature in the sociology of science, an expression of awareness concerning the aspects of scientific activity I have stressed. I quote one source for purposes of illustration (see also Rose and Rose, 1970: 159, 179ff, 210ff; Friedrichs, 1970: 114; Gouldner, 1970: 497f; in addition, see West, 1970):

> Scientific spokesmen have articulated an ideology of science which at one level focuses on the intrinsic value of knowledge. While the theologians of science have stressed the intrinsic values of science, the history of modern science, in effect, suggests that the movement has from the beginning leaned very heavily in the direction of an instrumentalism, characterized by an inversion of priorities whereby knowledge as power incarnate became its primary impetus and the disinterested search for knowledge became of secondary importance (Haberer, 1969: 321).[36]

Implicated in "prestigious and 'high science' methodologies" (the phrase is used by Gouldner, 1970: 55, to refer to sociologists but applicable in general to scientists), and, in addition, characterized by social isolation and role intensity, the visiting foreign scientist may be more likely to fully internalize (or internalize to a greater degree) and express the norms of science as ideology than his American colleagues. The visitor may be, like the religious convert, an uncritical promulgator of a strictly defined, almost caricatured conception of science and the scientific role. Coser (1965: Chapter 22) has argued that the "fairly unambiguous belief in progress" in science and society characteristic in the scientific community prior to the development of the atomic bomb is no longer adhered to. While this may be true for a certain segment of the scientific community, and especially of a segment of the American scientific community, our respondents are "believers in progress." Their view is consistent with the "conventional Western view of science"; their view is "still largely that of the Enlightenment, seeing it as a source of cultural liberation and human welfare that is marred only occasionally, marginally, accidentally" (Gouldner, 1970: 500). That visiting foreign scientists are more likely to adhere to this view than American scientists is problematic, but a viable working hypothesis. At any rate, the visitor's "Enlightenment" perspective is evident in their responses to two questions: (1) the perceived significance of "greater economic development" for their home country, and (2) the importance of the values of science in development. Consistent with data previously reviewed, more than 70 percent of our questionnaire respondents "agreed" with the statement, "The values of science should influence the values and ways of life of the people and leaders of my home country"; at the same time, 70.1 percent "agreed" that "what my country needs is greater economic development." Together, these responses can be interpreted as a reflection of the assumptionamong our respondents that science is a "high" if not the highest human value, and that it is compatible with the need for economic development (Table 41).

Excursus: A Note on the Structure of Scientific Revolutions

To the extent that the theses outlined in Chapters 2 and 3 are viable, they suggest a new chapter in the structure of scientific revolutions. Kuhn (1962, 1970) notes that one of the concomitants of "normal science" is the narrowing and rigidifying of education in the natural sciences. Scientific training "is not well designed to produce the man who will easily discover a fresh approach": but he optimistically adds that,

> . . . so long as somebody appears with a new candidate for a paradigm--usually a young man or one new to the field--the loss due to rigidity accrues only to the individual.

TABLE 41

PERCENTAGE DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY THEIR RESPONSES TO NORMATIVE STATEMENTS ABOUT THEIR HOME COUNTRY

Normative Statements	Responses[a] Agree %	Neutral %	Disagree %	Base N[b]	Total %	IQV %
1. My country should stay as it is, i.e., it should not change.	4.6	92.3	3.1	130	100.0	19.0
2. What my country needs is greater economic development.	70.1	21.7	8.2	134	100.0	67.6
3. A greater effort in my country must be placed on a rediscovery of its past.	23.1	48.5	28.4	134	100.0	94.5
4. The values of science should influence the values and ways of life of the people and leaders of my home country.	72.2	10.5	17.3	133	100.0	66.0
5. The problems confronting my country must be seen as international in nature.	70.6	11.3	18.1	133	100.0	68.5
6. My country should follow and develop its own course through history and not copy other nations	57.5	15.9	26.6	132	100.0	86.0

TABLE 41 (Continued)

Normative Statements	Agree %	Neutral %	Disagree %	Total Base N^b	Total %	IQV %
	Responses[a]					
7. There should be more international cooperation between my country and other nations	85.3	3.7	11.0	136	100.0	39.0

[a]"Strongly agree-agree," strongly disagree-disagree" collapsed to emphasize direction of responses. Mean IQV = 62.9.

[b]N = 140. Some respondents failed to answer on each item: four respondents failed to answer any of the items.

> Given a generation in which to effect the change, individual rigidity is compatible with a community that can switch from paradigm to paradigm when the occasion demands. Particularly, it is compatible when that very rigidity provides the community with a sensitive indicator that something has gone wrong (Kuhn, 1962: 165).

Optimism is a keynote of Kuhn's perspective: he refers to the "continuing evolution" of science (1962: 159), and to scientists as "reasonable men" (1962: 157). That Kuhn is indeed a "believer in progress" he himself affirms unequivocally in his 1970 "Postscript" to the second edition of The Structure of Scientific Revolutions; admitting the possibility (indeed, affirming the "fact") that scientific development, "like biological development" is "a undirectional and irreversible process," he writes: "Later scientific theories are better than earlier ones for solving puzzles in the often quite different environments to which they are applied. That is not a relativist's position, and it displays the sense in which I am a <u>convinced believer in scientific progress</u>" (1970: 206; emphasis added). It is tempting to assign Kuhn an identity common to ideologues of science; it may be more kind to point out the naiveté of his sociological imagination. "Narrowness and rigidity" in science is not simply a manifestation of normal science; professionalization and bureaucratization stimulate and reinforce narrowing and rigidification. If, as seems to be the case, these processes are characteristic of science, independent of the internal dynamics Kuhn focuses on, some resistance to "progress" should be expected. The question arises, is the supply of men who are "young" and "new," Kuhn's Bolsheviks of science, independent of socil processes and changes in social structure? Is it possible that the professionalization-bureaucratization of scientific activities within corporate, university, and governmental structures, and the diffusion of an increasingly pervasive ideology, will effectively decrease the supply of the young and the new men who make scientific revolutions? Being young and new may become increasingly impossible as men are "standardized"; deviation becomes not merely less likely, but more intolerable and more at the mercy of agents and agencies of social control.

Suppose Kuhn's conception of scientific progress is considered in terms of a cyclical pattern of some sort, e.g., a sinusoidal wave. Kuhn's conception entails an increase, over time, of some characteristic of the wave representing "progress," e.g., an increase in amplitude; it also requires a relatively constant period, i.e., revolutions will occur with some regularity. Such a conception seems to require an increase in amplitude with each revolution, a progressively amplifying oscillation. But at least two "damping" sources can be hypothesized. One is the convergence of dysfunctions (in professionalization-bureaucratization); this would have the effect of lengthening the period between peaks of scientific revolution, lessen the intensity of revolutions, progressively decrease periods of crisis, and progressively decrease the probability that (1) an individual scientist will conceptualize a revolutionary idea, and (2) that such a scientist will be recognized and precipitate a crisis. A second source is the "cost" associated with each revolution: Boulding (1970: 60-61), for example, argues that ". . . these dialectical processes which accompany scientific revolutions are costs, not revenues, and it is absurd to idealize them. They represent, as it were, the heat of crystallization in a process of essentially continuous change. The dialectical processes which they may introduce are a hindrance rather than a help to the growth of science." Scientific progress is not a function of "conflicts of theories"; science does not progress "by one theory conquering another in a revolution but rather by the slow growth of testable and tested images" (Boulding, 1970: 63).

Boulding's "heat of crystallization" analogy is noteworthy when considered in conjunction with professional-bureaucratic "rigidification." Crystallization is a change from the liquid to the solid state; during this process, particles "line-up" symmetrically and undergo a diminution in their "freedom" of motion; this state is generally characterized by retention of volume and shape. This suggests that Boulding, like Kuhn, is ignoring the possibility that some form of "cumulation of costs" progressively increases resistance to growth, or to change in general. The costs of dialectical, or revolutionary change may cumulate like fatigue products in animals during physical exercise periods--a temporary diminution of skills, power, and efficiency is followed by a "recovery" phase, and an increase in skill, power, and efficiency, i.e., "progress"; they may also cumulate in such a way as to continually decrease skills, power, and efficiency, e.g., during the life-cycle of animals. A costs argument cannot be defended without recognizing that it entails the possibility of a decreasing capacity in the system to recover, i.e., to progress having incurred certain costs. One effect of the convergence of dysfunctions is to produce just such a situation.

Gouldner's (1970: 500) conclusions about the "scientific revolution," while they are derived from a framework somewhat distinct from mine, are consonant with my own:

> . . . the "good news" and the liberating effects of the scientific revolution may now also need to be seen as an historically limited liberation. What is now required is to confront that hostile information which suggests that the scientific revolution has, under present social conditions, opened the prospect of global self-destruction and, more generally, that science has become an instrument through which almost all contemporary industrial social systems maintain themselves.

In Summary

The visiting foreign scientist works under the influence of the convergence of professional-bureaucratic dysfunctions in science. The ideology of science he encounters in the United States is rooted in an activity which is "closely tied to the vocabulary and needs of the body politic" (Friedrichs, 1970: 300).[37] To the extent that the capacity for scientific training and, more importantly, education, to provoke rational approaches and solutions to human problems is being eroded by the ideologicalization of science, the facilitative potential in the third-culture of science for contributing to development, and to social change in general, is increasingly unlikely to be actualized.

CHAPTER IV

SCIENCE, THIRD-CULTURE, AND ECUMENE

1. Professional Man as Modern Man

The conceptual link between work environment (including "conditions of work" and "ideology"), and the processes "development" and "ecumenization" is the individual's "societal orientation," i.e., his orientation to levels and units of macro-social structures. I have used a standard (though not standardized) vocabulary in classifying societal orientations as "traditional," "modern," and "post-modern." Working definitions for these concepts are based on Apter (1965), Etzioni (1968), and Miller and Form (1964: Chapter 19), modified in accordance with my own conception of what these orientations mean. The three can be considered hierarchically so that they reflect a change in scale from "local" to "ecumenical" systems at the level of individual perception and cognition.

The question I wish to consider in this section is whether there is any evidence that scientists are part of a social system out of which a post-modern, world society is emerging. Within the limitations of this study, the question resolves to whether our respondents manifest an orientation supportive of the "hypothesis" that the scientific community is a microcosm of an emerging world society.

The <u>post-modern orientation</u> is to the ecological interdependence of men and environments on a global, geospherical, bio-spherical scale. The basic objectives of post-modern man are to consciously, rationally stimulate the development of viable nation-states, incorporate them into a cooperative international system, and simultaneously to orient mankind to the necessity for transcending and ultimately "withering away" the boundaries and sovereignties of nation-states in the interest of creating a world society constituted of new interdependent but diverse societal forms. For the present, the post-modern man invests his energies and roots his self-concept in one or more international systems. Fully developed, the post-modern role is the role of an active participant in an emerging Ecumene. Recognizing the interdependence of population, social organization, environment, and technology (to use the factors of human ecology), post-modern men are oriented to manipulating and controlling these factors, a necessary condition for achieving their objectives. At the level of the self, the post-modern orientation is to the creation of conditions conducive to self-actualization, where self-actualization is conceived not simply in ego terms but in reference to the interdependence of self and society.[38]

The modern orientation is to the social-political, and especially technical-economic development and maintenance of the nation-state. Instrumental values are dominant, and "conquering" the national physical environment is a basic objective. There is in this orientation a growing sense of the possibility of directing social change (though the tendency is to think of society as an entity subject to the unadulterated approaches and methods of physical science). In general, the orientation to knowledge is technical, means are fixated at the technological level and the level of conventional power politics, and ends are primarily physical, technical, and economic. These ends are perceived to be dependent on the social and political stability of nation-states. The fully developed modern role does not implicate the individual fully or directly into the conscious direction of change; his commitment, even when he is involved in directing change, is to his professional career.

The third basic orientation is traditional, an orientation to the neighborhood, the local community, the region, and national culture--to their historic and symbolic meanings rooted in some "past"; that past is viewed by traditional men as inextricably linked through their lives and the lives of their kin or people to the future. The physical and social environments are considered essentially "given"; it is only in the realm of the physical that there is some sense of directing change. Folk knowledge is dominant and means-end schema are pre- or proto-scientific.

Given these working definitions, our respondents are, considering <u>all</u> relevant and available information, best characterized as <u>modern</u> in orientation.[39] The primary indicators for this characterization are: (1) image of the future, (2) normative orientation to home country, (3) involvement <u>in</u> social and political activities, and activities <u>as</u> social change agents, (4) optimism/pessimism concerning the future of the home country and of the world.

The question designed to elicit an "image of the future" response was specifically related to "home country" so that our interviewees could readily identify an entity meaningful for their everyday lives; for similar reasons, future was defined in terms of the next decade: "If you could picture your country in the best possible form, how would things look about ten years from now?" This question was followed by a question on whether or not they were optimistic about their home country achieving that future; seventy percent expressed optimism (Table 37, page 134). Responses to the "image of the future" question emphasized national industrial-economic improvements and growth; references to industrial-economic factors constitute 40.0 percent of all factors cited by all interviewees (Figure 6). The viability of the nation-state was taken for granted. Only three interviewees mentioned "internationalism," or

A. Factors in images

Factors	Number of times cited, all interviewees	Percent of total factors cited	Number of times cited as only factor
Industry-economy	53	40.0	13
Politics	30	22.6	14
Education	14	10.5	2
Basic science	8	6.0	1
Technology-applied science	6	4.5	2
Other	22	16.5	-
Total	133	100.0	

B. Major clusters of factors in individual responses

Cluster	Number of times cited
Industry-economy/politics	13
Industry-economy/education	4
Industry-economy/basic science	3
Industry-economy/politics/education	2

(N = 82)

Figure 6. Summary Statistics on Interviewees' Images of Their Home Countries' Futures

"international cooperation." A few of our interviewees noted the importance of achieving national-political-cultural reunification--of the two Germanies, the two Chinas, Okinawa and Japan, Hong Kong and China, and the two Koreas. Only one respondent conceived a movement toward regional integration, and that was toward a United States of Europe.

These responses recall the distinction between international-mindedness, and world-mindedness in Sampson and Smith (1957). They defined an "interest in or knowledge about international affairs" as characteristic of international-mindedness; the world-minded individual "favors a world-view of the problems of humanity . . ." and mankind is his "primary reference group" rather than any specific group or collectivity. A modification of the definition of international-mindedness is necessary to make it dimensionally comparable to world-mindedness; it should define a value-orientation, a frame of reference, or a world-view. In these terms, our respondents are international-minded, not world-minded.

The modern orientation--or, international-mindedness--is further reflected in data previously cited (Table 41: 151): our questionnaire respondents generally agreed with statements about their home country in which "economic development," "industrialization," and the maintenance of political boundaries were stressed. A high proportion <u>did</u>

agree with statements that suggest a post-modern orientation (statements 4 and 7, Table 41: 151) though the weight of all relevant evidence supports the assertion that they are modern men. I have already noted their lack of involvement in social and political activities, their high level of involvement in work activities, and their expressed satisfaction with their work. These data are all at odds with the post-modern orientation. They are, indeed, components of an image of man more like Seidenberg's (1950) post-historic man.

One of the important insights into the nature of our respondents may lie in the responses by our interviewees to questions on their optimism about the future. As Boulding (1964: 11-12), following Polak (1950) has phrased it: "One of the major elements, perhaps indeed the most important single element, which governs the dynamics of particular societies is the nature of the image of the future which prevails in them . . . the principle factor is not so much the particular content of the image of the future as its quality of optimism or pessimism." It will be recalled that a high proportion of our interviewees expressed optimism about (1) their home country's future, and (2) the world's future, during the next decade (Tables 37, 38: 134, 135). The quality of their optimism, however is reflected in the fact that they do not manifest a concern for actively and directly affecting the future, except through their commitments to and faith in basic science. To the extent that their optimism is an ideological orientation, as I suggested in Chapter 3, it does not appear that the professionalization of these young, mobile scientists is provoking or reinforcing a post-modern orientation.

The Primacy of "Profession" in the Modern Orientation of the Visiting Foreign Scientist

I suggested earlier that the visiting foreign scientists in our sample are "mainliner," that they are oriented to science as a profession, not as an occupation. I would like to examine here how professionalism is related to the visitor's role as a link between the United States and the "home country."

Our interviewees perceive themselves to be minimally involved in the scientific network that links their home country and the United States. Most of these scientists do not consider themselves active participants in a network that links their home country and the United States and is organized around developmental goals. Of those who do feel they play a role, the network referent is the "scientific community within which they generate and communicate scientific information (Table 42). A "formal network" is defined by the existence of a formal program of regular exchanges. In the two cases noted, United States funds (in one case provided by the Ford Foundation) support

TABLE 42

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THEY PERCEIVE THEMSELVES AS ACTORS IN A SCIENTIFIC NETWORK THAT LINKS THEIR HOME COUNTRY AND THE UNITED STATES, BY PRESENCE AND TYPE OF NETWORK

	Perceived Network Involvement			
	Role		No Role	
Presence of and Type of Network	N	%	N	%
Formal	2	2.4	1	1.2
Informal	29	35.4	11	13.4
No network	--	--	34	41.5
Other	5	6.1	--	--
Total[a]	36	43.9	46	56.1

[a]N = 82. See text for definitions and explanation.

the exchange program. An "informal network" is defined by the existence of more or less regular exchanges, but without a formal program. Regular work contacts between scientists in two countries is a necessary condition for "informal network." Two visitors said they were active in facilitating the exchange of scientists and scientific information between their home countries and the United States as part of an international scientific community within which they participate by publishing and otherwise exchanging information.

The future plans of our interviewees, and the factors which appear as major determinants in their decisions provide an interesting perspective on the saliency or work and profession in the modern orientation. Among our respondents, 56.0 percent expressed an intention to return home when their present commitments in the United States expired (Table 43). More detailed information was obtained

TABLE 43

DISTRIBUTION OF RESPONDENTS BY GEOGRAPHICAL PLANS FOLLOWING EXPIRATION OF PRESENT ACADEMIC COMMITMENTS IN THE UNITED STATES

Plans	Respondents N	Respondents %	IQV %
Return home	125	56.0	
Remain in U.S. indefinitely	20	9.0	
Move to another country	37	16.7	
Not certain	40	17.8	
Total	222	100.0	80.5

from our interviewees. Approximately 80 percent of our interviewees plan to return to their home country (Table 44). The saliency of work and profession is illustrated by the fact that of the 73 visitors who could be classified by factors affecting their decision (whatever their plans were), 59 (80.8%) mentioned professional factors. That

TABLE 44

DISTRIBUTION OF INTERVIEWEES BY GEOGRAPHICAL PLANS FOLLOWING EXPIRATION OF PRESENT ACADEMIC COMMITMENTS IN THE UNITED STATES

Plans	Respondents N	Respondents %
Return home	63	78.7
Stay in U.S. indefinitely	4	5.0
Not certain	13	16.3
Total	80[a]	100.0

[a]N = 82. One interviewee with degrees in social science and divinity planned to go to Taiwan to do missionary work. His home country is Switzerland. One interviewee could not be classified.

is, when asked why they planned to return home, or stay in the United States, their answers included references to scientific research, working conditions, and/or the job situation: for example,

> I plan to return to Africa to do research.
>
> I'm not certain; I'll go wherever I'm offered the best job.
>
> I will go back to Europe, to work in management development.
>
> I want to go into educational research at the university level in England.
>
> I'm going to look for a job in Canada.

TABLE 45

DISTRIBUTION OF INTERVIEWEES BY PLANS, AND FACTORS AFFECTING THEIR DECISIONS

	Factors Affecting Decisions							
	Professional		Moral Obligation		Contractual Obligation		Cultural	
Plans	N	%	N	%	N	%	N	%
Return home	47[a]	79.6	3	100.0	8[b]	100.0	3	100.0
Stay in the U.S. indefinitely	4	6.8	-	--	-	--	-	--
Not certain	8	13.6	-	--	-	--	-	--
Total[c]	59	100.0	3	100.0	8	100.0	3	100.0

[a]Six interviewees in this category (Return home-Professional) mentioned their visa restrictions as a factor; one said he would stay here if he could communicate more effectively with Americans; one has a position waiting for him in Japan, but he would like to stay here for economic reasons--he also explained that he has an elderly mother to care for at home; and one visitor said he will "probably return," but wants to get one or two years more experience here.

[b]One interviewee in this category (Return home-Obligation: Contr.) who is British said also, "I like London."

[c]N = 82. Number "not applicable" = 2; number "not classifiable" by "factors affecting decision" = 7: among the 7, 2 planned to return home, and 5 were uncertain.

Eighteen percent mentioned one of two types of "obligation," moral or contractual. The three responses classified as "moral obligation" were:

> I was teaching before I came to the U.S. I most probably will go back. I have family ties there, and an obligation to return to the university.
>
> I plan to return to Indonesia. It's part of the deal. I am obligated to the United States and to Indonesia.

Responses classified as "contractual" included specific reference to "leaves of absence," or "visas" and "passports." There was no sense of moral obligation expressed in these responses, either in the selection of words or the tone of the response. For example,

> I will return to Japan. I am on an exchange visa.
>
> I will return to Pakistan--but maybe I will go to Canada. As part of the exchange program, I must return to Pakistan to do research and teach at the university.
>
> I am on leave of absence from hospital in Japan.
>
> I will return to Japan because of my passport.

Interviewees classified under the category "Cultural" indicated they were more "at home" in their own country:

> I will go back to England, work in the civil service, do research in physics, though in a different field. I feel more comfortable in England.
>
> I will return to Japan. It is quite simple; I am more comfortable there.

> I think I'll go back to Japan. There is a possibility of staying here another year, but I will go back to my job in Japan [because I am more at home there].

Among those visitors who planned to return, only six said they were returning specifically because it was "their" country; in contrast to all of the other responses, these were distinguished by the explicitness of the respondent's identification with the home country. In these cases, work and profession were simply not manifested, thus underscoring the saliency of profession for the other respondents. A woman scientist from Turkey said, "It is home. Turkey has given us many things and we must pay her back." A South African social scientist mentioned "family" and "country" ties, then stated with emphasis, "I <u>am</u> a South African." The distinctive pattern in this set of responses, however, occurred among Israelis. Their responses stand apart for two reasons: (1) they exhibit a strong sense of identification with their home country in four of the five cases encountered, and (2) the strength of the identification is greater than in the two previous cases cited, the Turkish and South African scientists. The Israelis therefore deviate most distinctly from the "saliency of work and profession" pattern. In the four cases where identification with the home country was salient, the responses were emphatic and unambiguous both in words selected and delivery:

> A thirty year old geologist working in computer applications expressed some surprise when I aksed him why he was going back to Israel: "It is my home country!"
>
> A thirty-four year old plant physiologist said simply, "It's my home."
>
> A zoologist, thirty-one years old, planned a postdoctoral year at the Smithsonian. Then, he said, "I will return to Israel. That's my country!"
>
> In the fourth case, a thirty-nine year old ecologist said he was going back because (again emphatically) "Israel is my country!"

The fourth Israeli went on to emphasize the commitment Israelis have to protecting their national identity and to the political, social, and economic development of their nation. This set apart even more so than would have otherwise have been the case the response of the fifth Israeli in our interview sample. A thirty-four year old meteorologist, he conformed to the general pattern among our interviewees in stressing work and profession; but he was almost unique in the degree to which he subordinated interests, ties, and identification with his home country:

> I will stay here as long as I can. Everything is here--opportunity, my field of dynamic meteorology. I would be choked off if I went to a small country like Israel.

In an interesting and provocative aside, he asked me if his response surprised me. He predicted that I would find him unique among the Israelis in my sample: "They will all express a commitment to Israel, and say they are going back, but they are hypocrites. I am being honest about it."

It is impossible to provide an interpretation of significance in the case of the Israelis. My somewhat digressive account does, nonetheless, illustrate in an extreme the commitment expressed by our respondents to the viability of nationhood. There is, undoubtedly, a sense in which the problem of national identity is unique among Israelis. But the provocative challenge posed by the Israeli meteorologist to his countrymen suggests, in the broader context of this analysis, a conflict which may characterize all our respondents to some degree: the demands of work versus the demands of culture--the conflict between professional socialization in a trans-societal system, and primary socialization in a given society.

There is some evidence that such a conflict exists. More than 55 percent of our questionnaire respondents indicated that they plan to return home (Table 43: 166); but nearly eighty percent said they "would" <u>or</u> "might" accept a "permanent" job in a country other than their home country (Table 46). Our interviewees expressed a similar orientation, though less dramatically; about 50 percent said, "It makes no difference to me what country I work in"; this item is cross-tabulated with "plans" in Table 47. The data suggest a conflict between (1) the desire to participate actively and freely in the professional scientific community, and (2) the feeling that the home country is a "comfortable place" offering "culture

TABLE 46

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY WHETHER OR NOT THEY WOULD ACCEPT A PERMANENT JOB OUTSIDE THEIR HOME COUNTRY

Response	Respondents N	Respondents %	IQV %
Yes (would accept a permanent job)	49	35.5	
Maybe (might accept a permanent job)	57	41.3	
No (would not accept a permanent job)	32	23.2	
Total	138[a]	100.0	71.5[b]

[a]N = 140. Number of "no response" = 2.

[b]Based on collapsing categories "Yes" and "Maybe."

security" because it is, on the broadest level, "known." Thus, over 80 percent of those interviewees who said it does make a difference to them what country they work in plan to return home; but nearly 80 percent of those who responsded "No" also intend to return home. The conflict is clarified by noting that those respondents who said "No" indicated that the major factor they would consider was the quality of the work environment. The decision to return home was, however, not based on "quality of the work environment" for most of these visitors. There is some indication that this item elicited an "idealistic"

TABLE 47

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT IT MAKES ANY DIFFERENCE TO THEM WHAT COUNTRY THEY WORK IN, BY PLANS AFTER VISIT

	Response			
	Item: Does it make any difference to you what country you work in?			
	Yes		No	
Plans	N	%	N	%
Return home	31	81.6	32	78.0
Stay in the U.S. indefinitely	2	5.3	2	4.9
Not certain	5	13.1	7	17.1
Total[a]	38	100.0	41	100.0

[a]N = 82. One "unclassifiable"; one "not applicable"; and one interviewee responded, "I don't want to answer that question" when asked the column item.

rather than a "realistic" response; that is, it appears that many of our interviewees responded "No" because normatively it should not make any difference to a scientist what country he works in, as long as the facilities and personnel are good, and relevant to his research interests. When they were asked, "Does it make any difference to you what country you _live_ in?" 36 of the 64 who said "Yes" (56.4%) indicated _cultural_ as opposed to _professional_ factors were important in determining their response. Among the cultural factors cited were linguistic, experiential, and kinship ties to the home country (Table 48).

TABLE 48

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT IT MAKES ANY DIFFERENCE TO THEM WHAT COUNTRY THEY LIVE IN, BY FACTORS AFFECTING THEIR RESPONSE

Factors Affecting Response	Response — Item: Does it make any difference to you what country you live in?			
	Yes		No	
	N	%	N	%
Cultural (general)	36	56.4	-	-
Family	8	12.4	-	-
Personal	8	12.4	-	-
Professional	6	9.4	15	100.0
Other	6	9.4	-	-
Total[a]	64	100.0	15	100.0

[a]N = 82. Number of "no answer" = 3.

The conflict between the demands of the profession and those of the home country are, then, characteristic of "professional man" as "modern man." The demands of the profession, if not exactly international or global, are at least bi-national and probably multi-national; that is, a "pull" factor of the profession originates in at least one country other than the scientist's home country. This is true whether the home country is developed or developing. The probability is high that on research grounds alone the United States will exert a "pull" on scientists from outside its boundaries. The conflict between the pull of profession and the pull of home country seems to be resolved, in general, geographically by returning to the home country, at least eventually. But the saliency of profession in the modern orientation makes it clear that our respondents <u>are</u> implicated in a trans-societal system of scientific activities. Beyond the general and abstract commitments to international science evident in data previously cited, there is more specific evidence that illustrates how our respondents are implicated in the scientific community.

Our interviewees were practically unanimous in expressing "no preference" for the scientists of any particular country in terms of work or social contacts. They also report, in general, that their national identity has had no perceivable influence on their relationships with foreign scientists (Table 49). Admittedly, these are responses that are difficult to interpret; but they do suggest a "homogenization" of cultural identity among scientists and the establishment of a "work identity." It is difficult, incidentally, to see quite how the willingness to interact

TABLE 49

DISTRIBUTION OF INTERVIEWEES BY PERCEIVED INFLUENCE OF THEIR NATIONAL IDENTITIES ON THEIR RELATIONSHIPS WITH FOREIGN SCIENTISTS

	Respondents		IQV
Perceived Influence	N	%	%
Liability	5	6.8	
Asset	6	8.1	
Variable	4	5.4	
No influence	59	79.7	
Total	74[a]	100.0	64.5

[a]N = 82. Number of "no answer" = 6; number of "Don't know" = 2.

socially with scientists from anywhere in the world expressed by our interviewees is to be evaluated since they report relatively little opportunity for social activities; the normative willingness may signify a feeling that the commonality of scientists requires such a response.

In terms of actual behavior, our interviewees do report that scientific gatherings in nations other than their home country have helped them establish personal communication links with foreign scientists (Table 50).

With the reminder that shifting the data base back-and-forth from "all respondents" to "interviewees" to "questionnaire respondents" makes conclusions even about my

TABLE 50

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT SCIENTIFIC GATHERINGS OUTSIDE THEIR HOME COUNTRY HAVE ENABLED THEM TO ESTABLISH PERSONAL COMMUNICATION LINKS WITH FOREIGN SCIENTISTS

Establishment of Communication Links	Respondents		IQV
	N	%	%
Yes	51	72.8	
No	19	27.2	
Total	70[a]	100.0	78.9

[a]N = 82. Number of "no answer" = 12.

sample tentative. I would like, with due caution, to suggest (and in part reiterate) on the basis of the preceding discussion that (1) our respondents are modern men, (2) as modern men in science, they are subject to the conflicting demands of a trans-societal profession and of their home country, and (3) their commitment to science has meaningful trans-societal aspects, but these are variable and do not seem to warrant conceiving scientific activity in terms of an entity called "the international scientific community."

Bernal, in 1939, wrote that while science has been "from the start international," especially and most fully from the eighteenth century on, "the present century has marked a definite retrogression" (1939: 191). More recently, Rose and Rose (1970: 180ff) have commented that "while the individual scientist might maintain his universalistic ethic, it has increasingly become a reality for only an elite amongst scientists." Even in the full flowering of internationalism, which Bernal associates with the eighteenth and nineteenth century there were certainly geographical limitations on "internationalism"; and then, as in the past, the communication patterns and mobility implied by internationalism in science were a reality "to only a relatively small proportion of those who regard themselves as--and are regarded as--scientists" (Rose and Rose, 1970: 181). Perhaps, Rose and Rose suggest, internationalism "remains a predominant myth just because it is precisely [the scientific elite] who tend to write about the philosophy and ethics of science as an institution and activity" (1970: 181).

It is not by virtue of being professional scientists that certain men are or become post-modern in orientation; rather, it is by virtue of exposure to certain types of experiences. In a situation which would, viewed superficially, appear to offer excellent opportunity for realizing the potential in the scientific community for contributing to the birth of a post-modern world, that of the visiting foreign scientist, more factors mitigate against than actively encourage such a contribution. The positive contribution of outlining the specific conditions under which a post-modern orientation would be stimulated and/or reinforced is not going to be a virtue of this dissertation. However, I would like to suggest the following for consideration and exploration: (1) moving across societies is neither a necessary nor a sufficient condition for stimulating the post-modern world view; (2) more generally, physical mobility is neither a necessary nor a sufficient condition for stimulating such an orientation; (3) the significance attributed to cross-cultural or transnational participation as a stimulus for the growth of international cooperation, and for the emergence of a world society is at best problematic (e.g., Angell, 1967: 129); and (4) visiting foreign scientists (whether America or some other country is "host") are not, by virtue of being scientists, more likely to encounter experiences conducive to the post-modern orientation than other types of individuals.

Cross-cultural and transnational participation in science (as in other human activities) can increase in scale without facilitating developmental processes or the emergence of a world society. The emergence of an international system of activities can stimulate a concern among participants for their system and their roles independent of national and international systems in general. This concern is most compatible with the modern orientation because it takes for granted the international system of nation-states and simply makes the profession (for example) trans-societal without requiring a fundamental change in values. The "cultural pull factor" in the home country, for visiting foreign scientists, not only sustains the modern orientation but also makes a full commitment to science as a trans-societal profession difficult, though as I have noted, such a commitment would not necessarily mean a commitment to the post-modern orientation.

This does not deny the possibility of viewing the present (which I have captured in a limited and selected cross-section) as transitory--that is, the evidence I have reviewed might reasonably be interpreted in terms of a transition to the post-modern orientation, rather than as a modern orientation. Certainly, the least that can be required is that the emergence of a post-modern orientation, and a post-modern world, be viewed as a problem for inquiry.

In concluding this section on professional man as modern man, I would like to review the perceived impact of their cross-cultural, transnational experience among our respondents.

Looking Backward: In Defense of Pure Tolerance?

The concluding question on our interview schedule (slightly revised in our questionnaire) was: "Looking over all your experiences here, in other countries, and back home, what effect have they had on the way you view man, society, and the world?" In answering this question, our respondents almost invariably included a reference to "increased tolerance," if not literally then with a synonymous phrase. This pattern can be interpreted in at least two ways: it can, for one, be viewed as a manifestation of an emergent post-modern orientation--in this case, tolerance, following James Martin (1964) would be conceived as the opposite of ethnocentrism; a second interpretation is that it manifests an unwavering commitment to the modern world. My interview experience has left me persuaded that the second interpretation is the more viable of the two. Because of the quality of the interview situation, and in part because there were numerous "no answers" to the questionnaire version of the final question while all of our interviewees responded, I would like to discuss the latter respondents in some detail.

Let me begin by noting some general characteristics of the interviews on this question.[40] Responses were generally difficult to elicit. They were always formulated with reference to an international system (as opposed to a world system). The responses were consistently vague (as they were among our questionnaire respondents) even though the interview situation allowed probing. Many interviewees indicated explicitly (for most it was implicit) that they had not given this type of question much thought. There was, in most cases, a visible searching as the visitor sought to articulate changes that had taken place, but not been thought about, or for changes he felt he should have experienced. Even with probing, responses were generally brief; they were broad, abstract, often far removed from day-to-day experiences.

Seventeen (20.8%) of our interviewees reported their experiences had had "no impact" on them; 65 (79.2%) expressed an awareness of changes their experiences had stimulated in them. Figure 7 outlines the basic categories of response, differentiated along two dimensions, "psycho-social" (for references to human factors), and "material" (for references to material standards and perspectives). Twelve respondents whose frame of reference was the link between the United States and their home country are listed separately.

The best way to summarize responses to this final question is to illustrate each of the response categories in Figure 7 with one or actual responses:

(a) I have learned that "men throughout the world think the same."

(b) I have become "more tolerant of other ways of life." I have developed "a greater empathy for people in different nations."

(c) I have developed "a broader focus on people."

(d) I have learned, "through an increased awareness, that people all over the world are happy and full of life."

Category	Respondents N	%
PSYCHO-SOCIAL		
Psychic/cultural unity of mankind (a)[a]	16	25.0
Empathy/tolerance for human differences (b)	9	14.0
Broader perspective on mankind (c)	6	9.4
One big-happy-family hypothesis (d)	6	9.4
De-humanization hypothesis (e)	6	9.4
Humanization of interpersonal relations (f)	3	4.7
Social problems orientation (g)	4	6.2
MATERIAL		
Personal standard of living (higher) (h)	1	1.6
Subordination of materialistic needs and goals (i)	1	1.6
BI-NATIONAL		
U.S.--home country referent (j)	12	18.7
Sub-total	64[b]	100.0
No impact reported	17	
Total	81	

[a]Letters are for text references to categories.

[b]One interviewee said a change had occurred, but he was unable to articulate the change.

Figure 7. Response Categories, Interviewee Responses to Question on Impact of Their Cross-cultural and Transnational Experiences on Their View of Man, Society, and the World

(e) "The dehumanizing effect here is contagious."
"I have become more professional, less well-rounded."
"I have become less emotionally involved in things."

(f) "I am more involved in the importance of informal relations between teachers and students."
I have become "more comfortable in interpersonal relations."

(g) I have become "more interested in the plight of the 'have nots.'"

(h) It has "changed my standard of living" which is hither now than previously."

(i) I have become "less materialistic."

(j) I have become "more aware of economic similarity of the U.S. and Japan, and the social differences; I have a better appreciation of Japan's uniqueness."

Because of the intrinsic interest of the last category, and because it is the least descriptive category, I am including the core content of all the responses. The remaining eleven are:

I have developed "a greater sympathy for the American situation."

I have become "more independent. I think I was more sociable in Japan."

I have become "less tolerant of my home country."

I have become "more aware of 'liking' my home country."

"I am bothered by what is going on here" in your country.

"I have realized the complexity of U.S. problems."

"I have learned a lot about America."

"I have learned science; this can be done in America."

"Life is simplified here--no hazardous travel, and the mail is on time."

"I have to talk about World War II--people have kept enemy idea of Japan."

"I see people more as people--I would have despised an Arab as an Arab, but now I view him as a person. I have a worse opinion of American Negroes. I thought they were more cultured than Negroes in South Africa--but they're not. They believe they should receive certain things simply because they are Negroes and that is not right."[41]

In general, I would interpret the responses of our interviewees to our final question as consistent with my "modern man" hypothesis. They do, indeed, reflect a "growing awareness of the oneness of mankind," but not in any reasoned, active, or sophisticated way. The most important element missing in terms of the post-modern orientation is an <u>active</u> commitment to the growing interdependence of peoples they are aware of. The responses do not manifest a self-conscious striving to confront and incorporate some type of post-modern orientation. The consequences of our interviewees' experiences have been, relative to the images created by prophets of the scientific-world community, rather pedestrian to say the least.

The discussion so far, from work conditions and ideology (Chapters 2 and 3), to my "professional man as modern man" hypothesis, has, among other things, provided a basis for critically analyzing the terms and referents for "international scientific community" and "third culture of science." My objective in the following section is to explore possibilities for conceptual clarity in comprehending the system of world-wide scientific activities.

2. Notes on the Social Structure of Scientific Activities

The idea of an "international scientific community" or simply "scientific community" has been uncritically accepted by sociologists of science. In the first paragraph of the introduction to his *The Scientific Community*, Hagstrom (1965: 1) notes that his "discussion is limited to basic research in experimental sciences with well-established theories. In this type of research, the scientific community is relatively autonomous, and the group of colleagues is the most important source of social influence on research." Thus, the reader is invited to accept, with Hagstrom, the following text as a study of the scientific community; but nowhere is the reader offered an *explicit* definition of what the scientific community is, why it is a community (or, why it is referred to as one), and who the people are who constitute that community beyond the specific individuals Hagstrom has data for.

Ben-David, in a recent review article (1970: 12), attributes the formulation of the term "scientific community" to Michael Polanyi.[42] Polanyi used the term (and I quote Ben-David), ". . . as a description of the way scientists enforced strict discipline amidst a great deal of individual freedom, through training, refereeing of publications and purely informal sanctions of approval and disapproval. He also showed how this informal system was related to the intrinsic characteristics of research." In spite of the fact that Polanyi was more concerned with exercising his formidable talents as a philosopher than with contributing to a sociological study of science, Ben-David finds his construct "a perfectly adequate sociological formulation." This might be a reasonable assertion if Polanyi's formulation is viewed as a basis for asking sociological questions and constructing testable and exploratory hypotheses about science, and infusing "scientific community" with sociological content. Whether this is what Ben-David had in mind, sociologists of science have not pursued that course. Some responsibility for this rests with Professor Shils; his usage of the term "scientific community" (e.g., 1954, and 1956) was, I think it fair to say, biased by his reflections on the "atomic scientists' movement," and used more than it was subject to test and refinement.

More recently, Thomas Kuhn (1969: 177) has argued that "A scientific community consists . . . of the practitioners of a scientific specialty"; or, with reference to the "paradigm concept," "A paradigm is what the members of a scientific community share, and, conversely, a scientific community consists of men who share a paradigm."

Even if all of this has stimulated the imaginations of sociologists of science, it has made precious little contribution to our understanding of the structure of scientific activities; this is especially true because of the emphasis on homogeneity in science which the concept of scientific community sustains. If, in the case of Kuhn, a definition of scientific community must follow from a definition of paradigm, then we are not much advanced beyond Polanyi's formulation. The debate over "paradigm" has recently been resurrected with publication of the second edition of Kuhn's The Structure of Scientific Revolutions. The 1969 "Postscript" has not satisfied at least one critic (Shapere, 1971) that "paradigm" has been reasonably clarified and defined; it is certainly not adequate to the task of constructing a "tight" definition of scientific community.

Considering the problematics of the "norms of science" as shared should statements, it is not surprising that "scientific community" is beset with problems from the sociologist's perspective.

In attempting to develop some guidelines for comprehending scientific activities sociologically, it would be useful to consider what sociologists mean by "community" and "international community." This is not a particularly rewarding task; it is not likely to provide us with a rigorous standard for conceptualizing scientific activity. Definitions of community have undergone multi-dimensional metamorphoses; one of the main lines of development has been from a "locality" based conception of community to a modern conception which seeks to detach community from geography, territory, locality. This development is revealed (though not, so far as I can tell, intentionally) in a definition E. C. Lindeman contributed to the Encyclopedia of the Social Sciences in 1934 (page 203):

> A community, if we define its explicit elements, is any consciously organized aggregation of individuals residing in a specific area or locality, supporting such primary institutions as schools and churches and among whom certain degrees of interdependence are recognized. This definition includes hamlets, villages, towns, and cities. A community, if we define its implicit elements, is any process of social interaction which gives rise to a more intensive or more extensive attitude and practice of interdependence, cooperation, collaboration, and unification. This latter conception omits all considerations of locality.

The distinction between "explicit" and "implicit" elements reveals the transition from a traditional conception of community to a modern conception which has developed in response to the increase in scale of human activities and the necessity for conceptualizing the "prosaic activities" of ecumenization. This is the objective where Useem (1963: 482) uses the term international community, "to refer to any group formed of people who stem from disparate societies, who regularly interact through interpersonal contacts and communication networks, and who share mutual interests and a common ethos." This usage, Useem notes, "detaches the sociological meaning of the community from its conventional geographical reference points." If this is accepted as a working definition of community (as opposed, for example, to a definition such as Martindale's (1964: 69) "a set or system of groups sufficient to solve all of the basic problems of ordinary ways of life"), it becomes appropriate to consider the applicability of community to "prosaic activities" in the ecumene, including and especially those of scientists.

The meanings of "international" and "community" must now be considered in turn. In using the term "international," Useem refers to "disparate societies," not to "all societies." This is consistent with Webster's 1967 edition in which international is defined as "affecting or involving two or more nations," or "of, relating to, or constituting a group or association having members in two or more nations"; it is also in line with standard usage in social science (e.g., Kelman, 1965). When used with reference to the scientific community, however, "international" tends to connote "world-wide," or "universal." Calder (1970: 50), for a recent example, refers to "the international spirit of scientific research and the world-wide network of interchange and co-operation between research workers, regardless of nationality. . . ." Conceptions of the international scientific community derive from statements such as accompanied the opening of the Royal Society in 1662 in which invitation was extended to "all inquisitive strangers of all countries" (Rose and Rose, 1970: 179). The cognitive maps, and actual experiences of scientists, judging from my research and from the literature on communication in science (e.g., Crane, 1969; Griffiths and Miller, 1970), are strictly delimited, even if often "unstructured"; what seems to be needed at the level of nation-states is a concept (or set of concepts) capable of (1) differentiating bi-national and multi-national frames of reference, and (2) conveying variations in centrality and peripherality among nations in terms of their control over resources (measured in terms of quantity and quality), including scientific facilities and scientific personnel.

The elements of community Useem includes in his definition of international community are "regular interaction," "inter-personal contacts," "communication networks," "shared mutual interests," and "a common ethos." The problem with trying to define community is not so much one of elements included or excluded as it is one of conceptualizing, describing, and analyzing phenomena commensurate with their degree of complexity, homogeneity, and structural durability. This problem, as well as the problems posed by using the term "international" can be clarified by reviewing our respondents' activities in the trans-societal system of scientific activities.

Tables 51 and 52, based on our interview data, illustrate one way in which interaction and interpersonal relationships are delimited even within a narrow "area of

TABLE 51

DISTRIBUTION OF INTERVIEWEES BY PERCEIVED NUMBER OF SCIENTISTS IN THEIR FIELD OR AREA OF SPECIALIZATION, HOME COUNTRY[a]

Number of Scientists, Home Country	Respondents N	Respondents %
Fewer than 25	16	22.3
25-50	10	13.9
50-100	11	15.3
100-300	17	23.6
300 or more	13	18.1
Don't know	5	6.8
Total	72[b]	100.0

[a]The frame of reference for most interviewees was "area of specialization" (39); 28 used "field," broadly defined; for 5 the frame of reference was not determinable.

[b]N = 82. Number of "no answer" = 10.

specialization" (e.g., ring theory), or a broad field (e.g., mathematics). The responses do not necessarily reflect the actual number of persons in the interviewee's specialization or field; they do manifest a cognitive map. The question which generated the data in Table 51 was open-ended; the

TABLE 52

DISTRIBUTION OF INTERVIEWEES BY NUMBER OF SCIENTISTS IN THEIR AREA OF SPECIALIZATION OR FIELD, HOME COUNTRY, THEY KNOW PERSONALLY

Number of Scientists Known Personally	Respondents N	Respondents %
All	15	20.8
Most	13	18.1
Some	40	55.5
One or two	3	4.2
None	1	1.4
Total	72[a]	100.0

[a]N = 82. Number of "no answer" = 10.

frame of reference, i.e., field or specialization, was not specified. The responses indicate (1) the variation in saliency of field or specialization, (2) variations in "perceived density" of one segment of the visitor's "scientific community," and (3) variations in the extent to which the visitors are part of an interpersonal network (Table 52).

The extent to which interpersonal contacts are an important part of scientific communication is one of the factors which must be considered in evaluating the applicability of "community" for describing and interpreting scientific activities. While research in the area of scientific communication is probably the fastest growing

specialty within the sociology of science, the relative incidence of and the function of face-to-face interaction among scientists remains obscure. Meetings seem to be important for establishing new contacts and entering informal networks (Lin, Garvey, and Nelson, in Nelson and Pollock, 1970: 31, 35); the significance of meetings, however, seems to be different for physical as opposed to social scientists. The social scientists have ineffectual premeeting networks, and the national meetings are important for establishing relationships with people working in given areas of specialization (Garvey, Lin, and Nelson, in Nelson and Pollock, 1970: 76).

In their study of sources from which scientists acquired prepublication information (for articles subsequently published), Lin, Garvey, and Nelson (in Nelson and Pollock, 1970: 50, 59) found that "face-to-face" sources were cited most often (39.6% in a sample of 277 engineers, physical and social scientists); preprint or prepublication drafts ranked second (29.5%), and correspondence with authors ranked third (15.1%). Interpersonal interaction may also be a function of the complexity of the message being communicated: this highly speculative hypothesis has been formulated by Wolek (in Nelson and Pollock, 1970: 233) as follows: ". . . the probability that a communication will involve interpersonal interaction between source and receiver varies directly with the complexity of the message communicated."

It is reasonable to assume that the incidence of and function of face-to-face interaction varies in science. Among our questionnaire respondents interpersonal contacts do not appear to be as important as the exchange of printed materials (Table 53). Given the fact that they are for the

TABLE 53

DISTRIBUTION OF QUESTIONNAIRE RESPONDENTS BY RANKED IMPORTANCE OF MEANS OF SCIENTIFIC COMMUNICATION IN THEIR WORK

	Ranked Importance					
	1		2		3	
Means of Communication	N	%	N	%	N	%
Letters	76	58.0	23	20.8	16	21.3
Telephone	2	1.5	2	1.9	2	2.7
Meetings	13	10.0	36	32.7	17	22.6
Preprints/reprints	31	23.6	38	34.5	14	18.7
Personal visits	8	6.1	9	8.2	26	34.7
Other	1	0.8	2	1.9	0	0.0
Total[a]	131	100.0	110	100.0	75	100.0

[a]N = 140. The number of respondents who failed to respond for at least the first rank = 9.

most part physical and biological scientists, it is not surprising that preprints and reprints are an important means for communicating scientific information (Hagstrom, 1970: 104).[43] The fact that 58.0 percent ranked letters first in importance is surprising, though this may reflect their activities as potential and actual visitors in establishing and maintaining contacts in different countries.

Still another indication of why "international scientific community" is sociologically inadequate is the tendency for professional activities to be centered in the developed nations. The professional scientific societies our respondents belong to are predominantly located in developed countries (Table 54). Most of the "core" journals,

TABLE 54

DISTRIBUTION OF RESPONDENTS BY MEMBERSHIPS IN SCIENTIFIC SOCIETIES AND LEVEL OF DEVELOPMENT OF COUNTRY IN WHICH SOCIETIES ARE LOCATED

	Memberships	
Level of Development	N	%
Developed	112	60.3
Developing	22	12.7
Developed and developing	51	27.0
Total	185[a]	100.0

[a]N = 222. Number of respondents reporting "no memberships" = 37.

therefore, are published in developed countries, and our respondents' publications usually appear in these journals.

One indication of the extent to which scientists are in fact "international" is the relative significance of international meetings. The frequency of participation in international meetings among our interviewees is, relative to participation in national meetings, very low (Table 55).

TABLE 55

PERCENTAGE DISTRIBUTION OF INTERVIEWEES BY FREQUENCY OF PARTICIPATION IN PROFESSIONAL MEETINGS AT REGIONAL, NATIONAL, AND INTERNATIONAL LEVELS

Level	Frequency					
	Very Often	Often	Seldom	Never	Total	
	%	%	%	%	Base N[a]	%
Regional	19.5	20.8	37.5	22.2	72	100.0
National	42.0	25.8	16.1	16.1	81	100.0
International	8.0	17.3	33.3	41.4	75	100.0

[a]N = 82. Number of "no answer" by "level" = 8, 1, and 7 respectively.

This is certainly not "surprising." It is, however, noteworthy as an indicator of the extent to which "international" is a meaningful referent for the individual scientist's professional activity, and the extent to which transportation facilities stimulate and facilitate access to scientific gatherings in all parts of the world. In comparison to past activities at the international level it is possible that there has been an increase in the level of participation by scientists in international meetings.

This would be a reasonable comparison, though some observers, like Bernal, and Rose and Rose, argue that there has been a decrease in international activity among scientists in general. It is, however, also important to contrast "ideas" with "activities." The idea of an international scientific community in which scientists and scientific information move freely about without encountering "obstructions" appears to be generally accepted by the scientists who participated in this study, as well as by the American graduate students in science I interviewed in an earlier study (Restivo, 1966: 18). In the earlier study, ninety-five percent of a sample of forty advanced graduate students in the physical and biological sciences said they believed there was such an international scientific community. Among the visiting foreign scientists in this study, 128 of the 201 who responded to the question, "Is there any country (or countries) whose scientists and scholars it is difficult or impossible for you to communicate regularly and freely with?" (questionnaire version), responded "No."[44] Those respondents who felt there were barriers to the free flow of scientists and scientific information believed these to be consequences of language differences or political situations (Table 56). The significance of political barriers perceived by our respondents deviates sharply from the reasonably well-documented position argued by Rose and Rose (1970: 181): "Safe conducts across national boundaries are not easily given to atomic physicists,

TABLE 56

DISTRIBUTION OF RESPONDENTS BY PERCEIVED MAJOR OBSTACLES TO INTERNATIONAL SCIENTIFIC COMMUNICATION

Obstacles	Respondents N	Respondents %
Language	33	45.3
Politics	37	50.7
Other	3	4.0
Total	73[a]	100.0

[a]N = 73, number of respondents who felt barriers existed.

or researchers on chemical and biological warfare, and for industrial scientists the bonds of secrecy and loyalty are tied even more narrowly to the individual company for which they work. None of these could find Bernal's internationalism readily applicable to his own activities today." The question of whether barriers exist was designed to elicit a personalized response (it did among our interviewees), i.e., had the respondent encountered any obstacles in pursuing his scientific goals. If the assumption that our respondents answered in terms of their own experience is valid, the results obtained suggest one of two possibilities: (1) there are, in fact, no barriers (which is what 128 respondents indicated), or the barriers are primarily due to language differences and therefore not likely to prevent dissemination of important findings for very long given translation facilities, and (2) there are barriers to scientific communication between and among nations (which may manifest not only political situations but lower-level organizational tendencies, e.g., to secretive research (Hagstrom, 1970: 107, 124)), but our respondents have not engaged, or had to engage in scientific activities in which they would encounter barriers. The latter interpretation seems more reasonable. Political barriers may be a reality only to those relatively few scientists who try to "live" international science or to promote it by behaving *as if* a world-wide scientific community existed; they may have the most realistic appreciation of the extent to which the free flow of scientists and scientific information is either facilitated or obstructed by political and other factors. The significance of whether barriers exist or not may, to hazard an "hypothesis" concerning the scientific "masses," be attenuated by the capacity of a professional-bureaucratic work environment to generate within its own boundaries meaningful and satisfying work experiences.

Finally, as further evidence for the need to construct a conceptual framework which is not burdened by untested, untestable, and ideologically-rooted assumptions of homogeneity and progressive growth in science, I would draw attention to the literature on growth patterns in science represented by the works of Crane (1969), and Griffith and

Miller (1970). The theoretical conclusions of this type of research are illustrated in the following excerpt from Griffith and Miller (1970: 137):

> Low levels of communication and few links among researchers are associated with very early periods of growth within a specialty. Communication links increase as the specialty grows, and the active researchers within the specialty evolve for a brief period of time into a highly coherent group. As activity at the research front of the specialty slows, and the specialty loses interest, the group may evolve into a variety of possible states. The highly coherent groups which have been identified and studied have come apart in a variety of ways, some reverting to a loose network and others being polarized into several schools.

When such findings are considered in conjunction with my own data, the inadequacy of "international scientific community" for conceptualizing the social structure of scientific activities on a world-wide scale is patently evident.

The increase in scale of scientific activities has prompted Kenneth Boulding to refer not to an international scientific community but to a "super-culture," an idea more liable to stimulate the public imagination than contribute to scientific description and understanding. The anthropologist B. W. Aginsky's concept of a "lateralization" is better designed for the latter; a lateralization is composed of

> . . . individuals who are interrelated and participate in varying degrees sometimes as an organized group and sometimes with little structured organization, with relatively little interference or control from the plural "governments" under which they, as

> individuals, live that portion of their lives. There are present varying degrees of similarity in, for example, activities and skills, material objects, ideas, and goals, which means some degree of cultural similarity (1954B: 5).

> Lateralization . . . must be understood as a person to person contact of less than the total population of the [societies] involved maintained through time by the interaction of individual members of plural locus cultures who have similar cultural participations and who have a system of communication and control by means of which rapid communication and thus diffusion is constantly going on in all directions (1954B: 13).

While Aginsky's concept represents an important contribution to the conceptualization of the "prosaic activities" in ecumenization, it remains (in spite of more recent refinements) substantively tied to his early research among the American Indians of the Far West. His conceptualization does not incorporate the complex interdependence between inter- and intra-national forces prominent in the exchange-of-scientist and other science-related linkages between and among nation-states.

The special utility of the concept "third-culture of science" is that it focuses explicitly on scientific activities as part of the modernizing linkages between and among nation-states. The working definition introduced on page 19 was (with minor changes): "The third-culture of science refers to the cultural (including intra-scientific) patterns created, shared, and learned by scientists of different societies who are in process of relating their societies or sections thereof to each other--the scientific role in this linkage is a modernizing role carrying the potential for relatedness, perspective, and participation in the ecumene." The utility of this concept for the task of conceptualizing scientific activities on a world-wide scale is that it emphasizes an important relationship between science and society, the basic focus of my research. Its drawbacks as a concept are several. The phrase has entered the literature of the sociology of science in an entirely different context through S. A. Lakoff's (1966) critical evaluation of C. P. Snow's two-cultures idea. The term furthermore reflects its roots in bi-national studies. I have, following the Useems, broadened the empirical referent for "third-culture" to include international or multi-national linkages. But the concept "culture" is, like the concept "community," not a standardized research concept. I have no intention of attempting to resolve problems of definition. Rather, I prefer to retain the concept "third-culture of science" to refer to those patterns--implicit and explicit, manifest and latent, material and non-material, conscious and unconscious, conflictful or cooperative--created (or, being created) out of the interpersonal contacts of scientists from plural societies. The concept "athird-culture" can be considered to be on the same plane of abstraction as "culture"; conceptualization of scientific activities on a world-wide scale must be carried out on a different plane. The literature on networks and sets provides a starting point for such an analysis. In introducing these and associated concepts, my intent is to suggest the viability of a "vacabulary" and not a full-scale conceptual analysis. Several ideas, some already introduced, can serve as a prelude to those suggestions.

(1) The locus of "international community" for respondents in the present and an earlier study (Restivo: 1966; see also Vanderpool, 1966) is either (a) a select few countries, for example (and especially) the United States, the Soviet Union, and Japan; or, another set often cited, the United States, the Soviet Union, Germany, and Japan. Such sets invariably include the United States and the Soviet Union, or (b) a region (as in the response, "the United States and Western Europe). Conceptually, the subjective referent for "international scientific community" is limited to those countries which are major centers of scientific activity; sometimes, a country on the periphery is mentioned because of the outstanding reputation of one man or a prestigious institute (e.g., the Institute for Advanced Mathematics in India). Behaviorally, the subjective referent is much more limited. At this level, the subjective locus can be delineated by determining the national location of the scientific societies to which scientists belong, their level of participation in these societies, and their professional ties with individual scientists and scientific organizations around the world (Cf. Crane, 1969, and 1970; Storer, 1968).

(2) More than 80 percent of our respondents have spent at least their last five years in a college or university (Table 57). This milieu tends to isolate them from regular,

TABLE 57

DISTRIBUTION OF RESPONDENTS BY PLACE OF WORK, LAST FIVE YEARS

Place of Work	Respondents N	Respondents %
University or college	175	83.0
Government	26	12.3
Industry	10	4.7
Total	211[a]	100.0

[a]N = 222. Three respondents who checked "other" and eight who said "None" have been excluded.

as well as intermittent contact with scientists in government and industry--this is a generalization for university scientists, who seem to interact mostly with scientists in their own departments (Hagstrom, 1970: 108-109); this limits the number and types of scientists within any given university scientist's matrix of potential and actual relationships.

(3) Approximately 45 percent of our respondents are from developing countries; but about 68 percent of all our respondents have, at least for the last five years, been employed in a developed country (Table 58). For them, the

TABLE 58

DISTRIBUTION OF RESPONDENTS BY LEVEL OF DEVELOPMENT OF COUNTRY(IES) THEY HAVE WORKED IN, LAST FIVE YEARS

	Respondents	
Level of Development	N	%
Developed	144	67.9
Developing	68	32.1
Total	212[a]	100.0

[a]N = 222. Number of "indeterminate" = 5; number of "no response" = 8.

"mass" of the "international scientific community" is concentrated in the colleges and universities of the developed countries; this means that their conceptual and behavioral referents for "international science" are defined by the locus of institutions of higher education in the developed countries.

(4) Our visitor's trip was, in general, stimulated by the centripetal "pull" of the United States as a (or, according to many of our interviewees, _the_) major center in science, a consequence of the "heavy mass" of U.S. science which is a function of the number of scientific workers, societies, and journals in the U.S., the high level of U.S. technology, the high evaluation accorded American scientific resources. The visitor's decision to come to the United States was, generally, a personal one, stimulated

or encouraged by a major professor or by an American professor who visited the scientist's home country. In some cases the potential visitor contacts an American scientist whose work interests him and arranges to work with him as a graduate student or colleague. In other cases, the trip is promoted by a major professor or supervisor who is a link to an American scientist.

(5) The "international scientific community" for the working scientist may consist of his linkages with a few to hundreds of scientists in a few countries through publications, especially journals, preprints and reprints. In some cases, there are four or five scientists working in a highly specialized field who, while working in different countries, maintain regular and intimate contact, including face-to-face meetings; this was the situation described by one of our interviewees, a mathematician working in group theory.

(6) Any form of mobility, especially if it involves a shift of field or specialization, closes off some relationships and opens others; the high level of specialization and the complex division of labor make virtually impossible to maintain communication with those scientists whose field or specialization you move from, or whose country or laboratory you leave. The effects of mobility, of course, depend on the extent to which the colleagues you leave behind are doing research related to your specialty.

(6) It is a commonly expressed fact among scientists and students of science that within a given subject area, field, or specialization, specializations and sub-specializations are so intensely cultivated that communication between and among specialists varies from difficult, to superficial, to virtually impossible.

Science is not, it should be more than evident at this point, a homogeneous entity; more important is the dynamic nature of scientific activities that careful study reveals, a revelation that may be startling only in reference to the conventional wisdom concerning what sicence is. How this heterogeneity and dynamism might be conceptualized is suggested in the following paragraphs.

Social Networks and Social Sets

A _social network_ is distinguished from a _social group_ as follows (Srinivas and Beteille, 1964: 166):

> A group is a bounded unit. A network, on the other hand, ramifies in every direction, and, for all practical purposes, stretches out indefinitely.
>
> Networks can be either close-knit or loose knit. . . . The chain of relations emanating from a person may either lead back to him, or it may not . . . in the limiting case, a close-knit network becomes a group (or a category).

Srinivas and Beteille note further that "A social network can be viewed as a set of concrete interpersonal relations linking the individual to other individuals who are members of diverse systems of enduring groups and categories. Here we represent the network from the viewpoint of the actor, and there are as many networks as there are actors in a social system." They distinguish between networks that are (1) "unitary" (I will call these "single-bonded") such as the "network of relations regulating the flow of goods and services" which is the economic system (other single-bonded networks include the political system, religious system, and educational system), and (2) "composite or multi-bonded, i.e., the "concrete networks of interpersonal relations."

As a first approximation, the third-culture of science is carried by a social network, multi-bonded and loosely-knit, with variations in bondedness and knittedness within particular sub-systems of the broader network. It is reasonable to conceive science in network terms because there are transportation-communication-exchange linkages between and among scientists and scientific organizations or groups.

Mayer (1966: 102) reviews the usage of the concept social network in Radcliffe-Brown, Firth, Barnes, and others. His summary conclusion is that ". . . there has been an attempt by social anthropologists to put forward two concepts for dealing with social situations in which collections of people are found that do not form groups.

One is the 'unbounded' network of relationships between pairs of people, making up a field of activity. The other is the finite set of linkages initiated by an ego, which forms part of such a network."

Ginsberg (1934) defines a quasi-group as a "recruiting field for groups composed of individuals who "have certain characteristic modes of behavior in common." Thus, Ginsberg defines what Mayer (1966: 97) calls a classificatory group, or potential group. The classificatory group thus appears to be intermediate between the social category and the social group. Mayer (1966: 97ff) identifies a second type of quasi-group, the "interactive quasi-group" which is "ego-centered": they depend "for their very existence on a specific person as a central organizing force: this is unlike a group, in which organization may be diffuse. Second, the actions of any member are relevant only insofar as they are interactions between him and ego or ego's intermediary."

It is thus possible, with this vocabulary, to conceive world-wide scientific activities as a relational system constituted of categories, groups, quasi-groups, sets, action-sets, networks, formal and complex organizations, and identifiable core groups, cliques, factions, seminars, caucuses. This entire system is stratified at individual, group, organizational, national, and regional levels. The The advantage of the social network vocabulary is that it is ideally self-contained; the necessary concepts are logically related to one another. This seems to be a better starting point for conceptualizing scientific activities than "invisible colleges" and "social circles" (Crane, 1969).

It would have been much more desirable to begin my research at this point than to conclude it. However, my research was the stimulus for the search that led to my argument for a social network's vocabulary. Let me illustrate the type of scheme that might emerge from a careful study and application of this vocabulary.

There is a <u>set</u> of human beings who have the attributes associated with the position-role-status <u>scientist</u> (a social category. "Scientists" is a variable; individuals are "more or less" scientists. For example, if the criterion for being defined as and defining yourself as a scientist is possession of a Ph.D. in science from a recognized university, and if "degree status" is taken to be the measure of the degree to which an individual is a scientist, the category "scientist" would look, diagrammatically, like Figure 8.

The more "solid" the circle, the more distinct the boundary is; the darker the line, the more impermeable the boundary, i.e., it becomes increasingly probable as impermeability increases that an individual who penetrates a given boundary will define himself and be defined by others

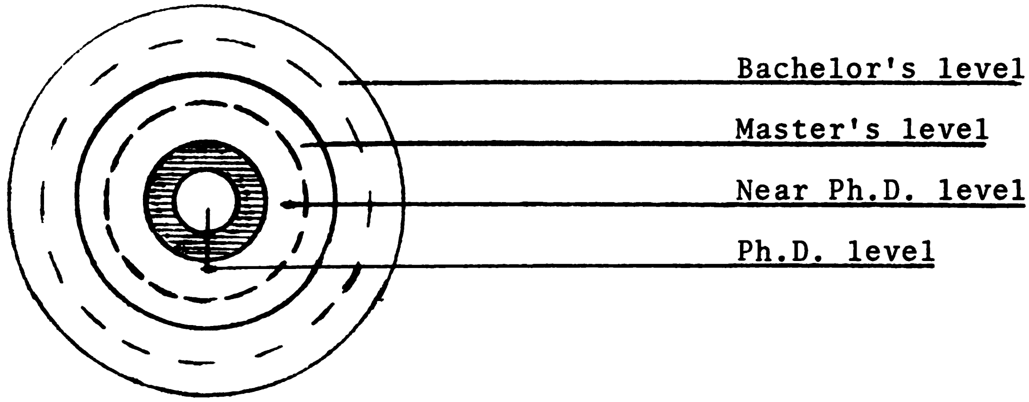

Figure 8. The Field of Scientists, Degree Status Criterion

(and especially by those in the central area) as a scientist (by the degree-status criterion). Individuals move from periphery to center; they can "rest" indefinitely at any point, but cannot move toward the periphery. Movement out of the plane of the field is also possible (e.g., in a change of profession). The outer circle can be defined as the boundary of the field, and an "intensity function" defined, to the extent that the central area is a "reference group," an individual anywhere within the outer boundary will experience an "attraction" toward the center, the intensity of attraction increasing as he approaches the center. This is a simple way of conveying the idea of heterogeneity on the level of scientific indentity.

Scientists are located in all parts of the world, but their activities, persons, products, organizations, and technologies emanate from, feedback to, and converge on major <u>centers</u> which are relatively stationary geographically. Centers can be defined regionally, institutionally, in terms of nations, or in terms of organizations. A "model" similar to that in Figure 8 could be used to convey the sense of "center" and "periphery" in science at this level. <u>Transcenters</u> (following, with modifications, Aginsky, 1966: 1-18) are defined as the convergence "points" of activities, persons, products, organizations, and technologies around goals which manifest a consciousness and desire among scientists to develop, maintain, and diffuse in perpetuity transnational systems of transportation-communication-and exchange in science. The distinction between centers and transcenters is not always clear-cut; but, for example, the American Physical Society is more like a center, and the International Conference on Weights and Measures more like a transcenter.

There are <u>rules</u> for combining the elements of the <u>set</u> of scientists; e.g., norms, values, belief-systems, "paradigms," and interests direct predictable associations of certain types of scientists with certain specifiable types of relationships. This usage of <u>set</u> and <u>rule</u> is a crude variation logical, mathematical, informational sense of these terms; but it is interesting to note that in the latter sense, a <u>group</u> is defined as "a collection of entities that possess the . . . property of <u>self-closure</u>. This is a way of saying that if we have a set of numbers, sequences, operations, or symbols and a <u>rule</u> for combining any two of them, the set becomes a group, <u>if</u> the result of their combination is an entity also belonging to the set" (Singh, 1966: 55). Correspondingly, we can conceive the collectivity of scientists as a set, and norms, values, interests and so on as rules for "combining" elements of the set, i.e., bases for group formation; such combinations would be "groups" within the frame of reference of science, i.e., they would be scientific groups. The combinatory rules must, obviously, be science-related. Thus, if several scientists discover that they have a common interest in "ring theory" and arrange to work together, they become a scientific group; if several scientists combine around a common interest in fishing, they are not under that condition as part of the set, they are not a scientific group. The concept of self-closure is interesting because it suggests the development of boundedness between and among scientists in the "set" according to specifiable rules.

Viewed in global perspective, the number and type of scientists undergo changes: new elements are added, and old ones shifted in position-status-role; scientists are constantly leaving the system in different ways, e.g., changing profession, semi-retiring, or dying. At any one point in time, we can identify different subsets (e.g., social groups, cliques, factions) which are more or less enduring. Under such conditions, changes in the social system of science are certain to occur. I have stressed the importance of "increase in scale" for understanding scientific activities, but have noted the importance of social changes that occur at the level of work, organization, and society, especially the consequences of professionalization and bureaucratization for scientific activities.

In emphasizing the "convergence of dysfunctions" hypothesis, I have not meant to define a unidimensional, unilinear phenomenon. The coming changes in international science (to paraphrase Norman Storer) are <u>likely</u> to be directed by the dysfunctions of professionalization and bureaucratization. But from a dialectical perspective, potential changes which would direct scientific activities toward new relationships in society, and/or greater autonomy, closer approximation to the "norms," and a stronger commitment to the non-ideological and non-dogmatic must be explored. One source for such changes may be grounded in two types of temporary groups, the international seminar, and caucus. The caucus in particular seems to provide a flexible form of organization for persons who must deal on a day-to-day basis with enormous increments in information and in general scientific activity. Such _disciplinary_ caucuses may be counter-processes in response to problems generated directly and/or indirectly by professionalization and bureaucratization. _Associational_ caucuses, such as the "radical caucuses," "Black caucuses," and "women's caucuses" which have proliferated at professional scientific meetings during the past three years, are counter-processes to professionalization and bureaucratization (usually) specifically. The caucus, then, can be studied as a counter-process with the potential for generating new developmental sequences, and new lines of development in science, including, for example (but not necessarily _probably_) forms of organization resistent to ideologicalization.

Beyond the questions of conceptualizing scientific activities, the framework I have sketched poses the problem of the potential among visiting foreign scientists for generating change _within_ science as well as in the relationships _between_ science and society. Clearly, the argument in this dissertation leads to the conclusion that their potential in both cases must be very low (and especially so in relation to their American peers). Of course, it is possible (and my assumptions about the impact of work conditions support this reasoning) that under new conditions their potential might change.

One incident during the interview phase, and responses to an item on the interview schedule reinforce the rationale for assigning a low probability to the potential among our interviewees specifically for becoming involved in, or the source of, a counter-process in science. The incident occurred while Mr. Vanderpool was conducting his interviews at a prestigious urban university. Student activists blocked the entrance to a science building where university officials were discussing protests generated by a departmental decision not to renew a professor's contract. In his interviews, Mr. Vanderpool discovered that the visiting foreign scientists who were working in the building were not very sympathetic to the students' tactics: regular access to their research facilities was extremely important to the visitors, probably more important than it was to their American colleagues, because they were here for a specified time during which they were expected to complete their projects. Whatever the nature of the conflict between students and administrators, the salient feature of the situation from the visitor's perspective was its impact on his ability to gain access to research facilities. This incident illustrates in an anecdotal way the impact of conditions of work on the visiting foreign scientists' potential for reacting to demands for changing routines.

On a different level, we asked our interviewees the following question: "Some scientists believe that the criteria for truth and verification in science will never change. Do you agree with them?" Their responses are recorded in Table 59. More than half agreed with the statement. The following illustrate types of reasons they gave for their responses:

> The empirical basis of science can't be changed.
>
> Science is physical proof, the only source of truth.
>
> One doesn't change the most successful way of obtaining truth.

TABLE 59

DISTRIBUTION OF INTERVIEWEES BY WHETHER OR NOT THEY BELIEVE THE CRITERIA FOR TRUTH AND VERIFICATION IN SCIENCE WILL EVER CHANGE

Statement: Some scientists believe that the criteria for truth and verification in science will never change.

Response	Respondents N	Respondents %	IQV %
Agree	43	53.1	
Disagree	18	22.2	
No response	16	19.8	
Don't know	4	4.9	
Total	81[a]	100.0	21.0

[a]N = 82. One response could not be classified.

> How can one find truth other than objectively?
>
> Experiment with nature is at the root of all truth. Testing theories against facts will always be there.
>
> Logic is immutable.

Objectivity and experimentation are the only source of scientific truth.

How could one change the only basis of science--it is immutable.

It is impossible to change logic or rationality.

The fact that nearly one-fourth of our interviewees failed to respond to this question, or said they "didn't know" could be interpreted as an indication of an inability to cope intellectually with the question, and therefore as an obstacle to considering science in terms of change and process. In general, the responses illustrate the extent to which science is internalized as an immutable and successful means for achieving "knowledge," or "truth." The degree to which such ideas are internalized, whether they can be articulated or not, is certain to be related to an individual's or group's capacity to generate change in the social system of science, or to respond (actively) to change.

Approximately one-fourth of our interviewees did not agree with the statuement. A sample of their responses is recorded here (1) to illustrate the nature of their disagreement, and (2) to place the potential among our interviewees for conceiving change in science in a broader perspective. The question I would like to close this section with is to what extent the following responses manifest a capacity for considering change in science and is this related to potential for actively confronting problems of change in the relationships between science and society?

Is this minority of respondents characterized by a higher potential for conceiving possibilities for change in general? It would appear reasonable to assume that scientists who feel science is "immutable" would be rather hesitant to challenge it, confront it creatively and critically, or develop a sense of commitment to change in a society within which scientific activities have been and are now, according to some scientists, the source of all human progress. Some of the reasons for "No" responses are:

> Logic and reasoning are subject to development according to development in thinking machines--a deterministic view will remain.
>
> Truth is a product of equipment--what was true ten years ago was a product of equipment.
>
> Science always changes; sometimes you get surprising results. Methodology changes

To the extent that these responses reflect a capacity for conceiving change in science, it is reasonable to inquire whether they reflect a general capacity to conceive change, and beyond that to initiate and/or respond to change.[45] I would be hesitant to attribute too much significance to the set of negative responses (hazardous as this may be methodologically) for two reasons: (1) the reasons given for responding "No" were not always directly related to the original question; and interpreted in the context of the overall response pattern, these reasons did not manifest a strong and unequivocal conception of the possibility for a change in the basic approach to truth and verification in human inquiry, and (2) the subordination of diversity and deviation in the work environment (the evidence for which is not restricted to data from my study) mitigates against the internalization or emergence of conceptions of change in scientific logic; it is unlikely therefore that very many visiting foreign scientists would conceive the criterion for truth in science as subject to change. To reiterate my conclusion as a working hypothesis, the visiting foreign scientist in American universities and colleges is a member of a set within the social system of science which is not likely to generate scientific groups interested in or capable of being recruited to or initiating counter-processes in science, or producing significant innovative, "revolutionary" science.[46]

3. Concluding Remarks

The research for this dissertation began with a relatively narrow focus on conditions of work among visiting foreign scientists at American universities. Flaws in the original sampling design which were outside our control increased the saliency of the study's exploratory aspect. This made it necessary to develop themes for organizing and interpreting results after the data had been collected. One theme which was part of the original design was the homogeneity of conditions of work and the homogeneity of response patterns. Two other themes were developed:

(1) the conception of the norms of science as part of an ideology, and (2) the increasing saliency and convergence of the dysfunctions of professionalization and bureaucratization. Two common factors in these three themes are simplification and specialization. In biology, these two factors are associated with "loss of diversity" and a decrease in the capacity of biological entities to respond adaptively to rapid changes in their environments, i.e., a decrease in evolutionary potential. The argument that derives from the analogy between simplification and specialization in sociology poses a serious challenge to those scholars who conceive science and society as two interdependent, inevitably progressive processes. My intention in exploiting this analogy is to link the results of my empirical research to the ecumenical framework outlined in Chapter I.

It is not difficult to understand why a comprehensive study of the historical "unfolding" of the increase in scale of human activities has led the creation or ecumenical theories which are sustained by the idea of progress. The commitment to the "idea of progress," however, is an example of what might be called "the fallacy of chronological causality," described by Durkheim (1938: 117-118): "The stages that humanity successively traverses do not engender one another. . . . All that we can observe experimentally in the species is a series of changes among which a causal bond does not exist." I do not interpret this to deny the validity of searching for processual laws, e.g., invariant sequences, which are theoretical and therefore conditional statements. In studying the increase in scale of human activities, our objective should be to construct theories which specify relevant variables, and the conditions for ecumenization and de-ecumenization. Theories must be disassociated from the metaphor of growth that has been an ever-present part of the West's intellectual history.

The ecumenical theorists who have incorporated one or another version of the idea of progress recall the responses of scientists in the early nineteenth century to the achievements of science and technology. Progress and the inevitability of social and scientific evolution are major and recurring themes in the Presidential addresses of the British Association for the Advancement of Science from its founding in 1831 to the death of Queen Victoria. Before and after Darwin, the "law of development" was assumed to govern stars, societies, flora, fauna--and it implied inevitable progress. In the wake of the economic depressions of the 1880's, English naturalists turned their attention to a phenomenon the Darwinists had recognized in warning against an oversimplified conception of organic evolution--retrogressive metamorphosis. In 1880, the zoologist E. Ray Lancaster published an essay titled "Degeneration:

A Chapter in Darwinism," in which he discussed devolution, "the retrograde movement of the evolutionary process toward simplification and degeneration" (Basalla, et al., 1970: 484).

Sensitized to the facts of evolution and devolution, it is possible to divest the concept "progress" of its metaphoric and prophetic content. General evolutionary progress can be defined, following Lenski (1970: 59), as "a raising of the upper level of the capacity of populations to mobilize energy and information in the adaptive process." Given this definition, the work of scholars such as Brown (1954) and Meier (1966) suggests that progress at all levels of human social organization now depends on the ability of the human population to adapt within the global ecological system; the raising of the upper level of the capacity of human populations to mobilize energy and information is now necessarily dependent on the creation of some form of global social organization.

Progress as herein defined is dependent on diversity. We know, for example, that genetic diversity is directly related to the capacity in a population for successful adaptation to rapidly changing conditions (Lenski, 1970: 55-56; Mayr, 1963). This idea has been formulated by Sahlins and Service (1960: 97) as "The Law of Evolutionary Potential": "The more specialized and adapted a form in a given evolutionary stage, the smaller is its potential for passing to the next stage." In other words, the potential for progress varies inversely with the degree of specialization and adaptation (Cf. Dahlsten, in Brown, 1971: 202-203; and Durkhein, 1938: 140).

The convergence of dysfunctions in professionalization and bureaucratization, and the standardization of work environments can be interpreted as a "loss of social diversity." Among our respondents, social isolation and role intensity are (1) manifestations of the loss of social diversity, and (2) conducive to the loss of individual diversity. The significance of this interpretation is the compelling evidence for the "loss of biological diversity" hypothesis, and the claim by some scholars that there is evidence of a "loss of social diversity" hypothesis (Cf. Molnar, 1961: 259).[47] The challenge posed by science to the established order, to reliance on faith and tradition, the promise of value-free inquiry, becomes transformed under the influence of institutionalization. The consquence of the convergence of dysfunctions on science as rational inquiry is the routinization of rationality.

We are experiencing a "mal du siècle," in the counterculture revolt against science and technology (e.g., Roszak, 1969), and in the Ellul-ian nightmares of a "dictatorship of the test tubes" (Ellul, 1964). But such disenchantment is founded on a very narrow conception of science, one rooted in professional roles, organizations, and Nobel prizes. Science is not professional scientific activity, nor "physical science," nor "technology"; it can be considered, to borrow Jacob Bronowski's phrase, "the method of all human inquiry." In this sense, one condition for Ecumene is the proper cultivation of science as an expression of human creative and critical intelligence. Science, whatever else it may or might be, is thus simply the process by which man raises the upper level of his capacity to mobilize energy and information in the adaptive process. The idea of a third-culture of science is critical because it emphasizes the link between inquiry and progress; it can be considered the system (or systems) which develops and diffuses "the method of human inquiry" in the process of ecumenization.

I have emphasized the dysfunctional impact of professionalization and bureaucratization on the third-culture science. In conclusion, it should be noted that the experiences of our respondents _do_ stimulate a commitment to work and profession that transcends conventional commitments to neighborhood, community, and society. This commitment carries with it a marginal status which may be a precondition for arousing the post-modern orientation. Nonetheless, it is impossible to ignore the fact that as scientists respond to problems of control and coordination in an interdependent world by simplifying, specializing, and standardizing, the evolutionary potential of human culture may be decreased.

FOOTNOTES

1. I use the term socio-cultural as a construct encompassing the traditionally distinguished large-scale units of sociology and anthropology, society and culture.

2. In addition to McNeill's descriptions of "increase in scale," see also Sjoberg (1960) for a comparable history of increase in scale based on economic change and industrialization.

3. In this and the following discussion of "One World," I follow, for the most part, Wagar (1963).

4. See also Boulding (1969) on the "super-culture," and especially B. W. Aginsky (1934A, 1934B) on "lateralization"; I discuss the latter concept on pages 202-203.

5. Price (1963) has attempted to express the rate of growth in science quantitatively. His data on the number of scientific journals and abstract journals founded as a function of time, the cumulative number of abstracts in various scientific fields and 1900 to 1960, and the growth of scientific manpower indicate an exponential growth of science from 1700 to the present. See also Weinberg (1958), and Skolnikoff (1967: 50-65). On the related problem of "brain drain" and "brain gain," bibliographic materials are readily available; see especially Dedijer and Svenningson (1967).

6. Among the many efforts directed at organizing highly developed human skills needed for development are those of the Engineering Manpower Commission and Scientific Manpower Commission, established by scientific and engineering societies in America; the Committee on Scientific and Technical Personnel in the Organization for European Economic Cooperation; and the variety of manpower committees and commissions established in the developing nations (see, for example, Hilliard, 1964). The United States' National Academy of Sciences, in cooperation with the Agency for International Development has sponsored a series of workshops on science and development (workshop proceedings are available from NAS).

7. Recently, various versions of a "science for the people" have emerged organized around the relationship between ecological problems and national and international politics; see, for example, Allen (1970), and Brown (1971). Important earlier statements are Bernal (1939), and Commoner (1963).

8. The term "scientific community" appears to have been introduced by Michael Polanyi in his The Logic of Liberty (1951) according to Ben-David (1970: 12).

9. In their study of visiting Fulbright professors, the Gullahorns (1962: 285) speculated that differences between natural (i.e., physical and biological) scientists and social scientists might be due to differences in background: ". . . social scientists reported by far the greatest number of casual acquaintances whom they saw frequently on a relatively superficial basis. Natural scientists, on the other hand, appear to have been much less gregarious in this respect. Perhaps we might hypothesize optimistically--without the support of data--that because of their backgrounds, social scientists were more sensitive to various cues for effective casual social interaction." On another level, Hagstrom (1965: 11; and 10, 245) has noted that "Deviation from vague norms is more likely than deviation from norms specified for a concrete set of practices. It follows that physical scientists are less likely to deviate from the norms of science and scholarship than are social scientists. . . ." See also Hilgard and Lerner (1951); Meier's highly speculative paper (1951); Roe (1952: 148); Lazarsfeld and Thielens (1958: 3); Hirsch (1961); Hagstrom (1964); Mills (1966: 39); Davy (1967); Weiss (1967: 156).

10. As Frank (1958: 60) notes, "Einstein stresses the point that advance in science is connected with an increasing remoteness of the general principles from statements of our common sense language. . . . The more remote the language of the principles is from common sense language, the longer becomes the mathematical chain that connects these principles with the statements which describe the actually observable phenomena by which the theory is checked." According to Oppenheimer (1958: 69), mathematics "plays a decisive part in theoretical physics . . . is not yet such an important element in biology and may never be. It is not such an overridingly important element in chemistry. . . . In an early science, one that is just begun, the difference is not very great [between the 'experience' of the scientist and 'experience' of all men]. In a science as old and specialized as physics, it is enormously great."

11. Bucher and Strauss (1961: 328-330) note that "Methodological differences can cut across speciality--and even professional--lines with specialists sharing techniques with members of other specialities which they do not share with their fellows." For example, "Alliances frequently dramatize the fact that one branch of a profession may have more in common with elements of a neighboring occupation than with their own fellow professionals. . . . For example, experimentally minded pathologists consult and collaborate with biochemists and other basic scientists, while pathologists oriented toward practice make common cause with clinicians of various specialties." This is why I stress below the importance of conditions of work rather than professional and/or academic boundaries.

12. "In emphasizing the international nature of scientific inquiry we have forgotten that science exists in a local setting. If that setting does not decisively mold the conceptual growth of science, it can at least affect the number and types of individuals who are free to participate in the internal development of science" (Basalla, 1967: 622).

13. Form (1946), for example, has noted "the all-pervading influence of work upon the lives of professionals. . . . The profession . . . becomes a whole social environment, nurturing characteristic social and political attitudes, patterns of consumption and recreation, and decorum and Weltanschauung." See also Greenwood (1962); Bucher and Strauss (1961); Becker and Strauss (1956); Glaser (1960); Gottlieb (1961); Rosenberg (1957: 298); Cottrell and Sheldon (1966: 232f); Caplow (1954: 124); Wilensky (1960: 553); Form and Nowow (1962: 441ff); Berger (1964: 231f).

14. Rescher (1970: 163-208) has suggested a distinction based on a conception of "exactness" that cuts across the conventional boundaries of the physical, biological, and social sciences--he finds "exactness" and "inexactness" in each of the major sub-divisions. Those who insist on emphasizing spurious distinctions between physical/natural, and social sciences are also referred to Synge's recent comments (1970: 354) on the need "to bring order and clarity to the concepts of modern physics" or Green's article (1970: 933) on nuclear interaction theory, in particular the opening quotation by M. L. Goldberger on the state of knowledge in the field just ten years ago: ". . . in surveying the field one is oppressed by the unbelievable confusion and conflict that exists. It is hard to believe that many of authors are talking about the same problem or, in fact, that they know what the problem is." The situation is, Green says, somewhat improved. But such commentary, where a knowledge of the history of the sciences is weak or nil,

should help dispel misconceptions which hinder not only the development of the sciences generally but research in the sociology of science.

15. In a conversation with me.

16. Refer to any of the regularly issued NSF reports on scientific and technical personnel in the United States.

17. We had considered including American scientists in the study; they were not included in part because of the difficulty involved in constructing a sampling frame of American scientists working in third-cultural settings.

18. Mr. Vanderpool, working towards his degree with me under the direction of Professors John and Ruth Hill Useem, is co-designer of this study.

19. The list was constructed from data provided for us on condition that our source of information be held in confidence.

20. Data on scientists is not readily available; comparison of our data with data on scholars, however, is not unjustified given the high proportion of visiting foreign scholars who are scientists.

21. On the problem of defining "profession," see Friedson (1970: 3-5).

22. It is possible that this continuity is exaggerated by contrast with any discontinuities between the home country and U.S. extra-work environments. To the extent that this is so, it is reasonable to expect the visitor to over-invest himself in the more "comfortable" continuities of the work environment. This would, of course, reinforce social isolation and role intensity.

23. Friedson (1970: 306f) uses the terms "client-dependent' and "colleague-dependent" in a slightly different context; but usage is somewhat similar to mine.

24. See also Kelman (1970), especially chapter one, and the introductory chapters in Deutsch (1970) for historical backgrounds and bibliographical material on international education.

25. Apter's conception of ideology is discussed in Chapter III.

26. The discussion in Chapter IV explicates some of these issues.

27. This is not necessarily contradicted by the recent publicity attending unemployment among American engineers and physicists, and evidence for a reversal of the "brain drain" which has in recent years "favored" the United States. Manpower demands must be evaluated not only within the context of the existing economic system but also in terms of a definition of human welfare. In the latter terms, there has been no decrease in the demand for high-level manpower, e.g., and especially, in medicine. It is one thing for an economic system to lose its capacity for absorbing highly-skilled individuals--it is another matter whether social and psychological conditions within that society manifest a general demand for such individuals.

28. The notion that the norms are operative and have remained unchanged has been most recently reinforced in a review article by Stephen Cotgrove (1971: 2): ". . . however important the norms of science may be for the effective functioning of science, this does not explain how these norms originated nor why scientists continue to accept them." The only reference he cites for the last part of the statement is Storer, whose work has no firm empirical foundation! See West (1960) who found substantial departures from the norms in a small sample of academic scientists. Sample size was 57, and West's methodology was not overly sophisticated--but his conclusion does not deviate from what my own expectations about norms and research; he found no association between the "classical morality of science" and productive research.

29. The following discussion does not treat questions of "truth" and "objectivity." Such questions are relevant but beyond the scope of the present inquiry.

30. M. R. Donaldson (1960) in an article on the sponsorship of tutorial work discussed the virtual disappearance of a gap between initial discovery and commercial product. Some of his examples, while temporal boundaries for "initial discovery" are sometimes open to question, as those for "commercial product" may be also, are nonetheless illustrative:

Product	Year Discovered	Year Produced	Elapsed Time
Photography	1729	1839	112 years
Telephone	1820	1876	56
Radio	1867	1902	35
Radar	1925	1940	15
Transistors	1948	1953	5

31. "Motives may range from the desire for personal aggrandisement to a wholly 'disinterestedness desire to

know' without necessarily impugning the demonstrable fact that the thematics of science in social structure of the tim. . . . It is neither an idle nor unguarded generalization that every English scientist of this time who was of sufficient distinction to merit mention in general histories of science at one point or another explicitly related at least some of his scientific research to immediate practical problems" (Merton, 1957: 608-609).

32. Hirsch (1968: 124) quotes a scientist in his study of American science noting that "The practice of science is becoming less for its own sake than for the advancement of scientists." More profoundly, Jaspers writes (1961: 200): "Scientific research as such is not yet the bond of the knowing. In general, it links only the intellect of men--this mere point of over-all consciousness, in which everyone can agree with everyone else on logically or empirically cogent knowledge." Note that both "science for its own sake" and "science for the sake of the advancement of scientists," to the extent that they can be distinguished, are both intra-science and disconnected from the general problems of society.

33. Another basic characteristic of "profession" is also problematic: ". . . there appears to be no reliable information which actually demonstrates that a service orientation is in fact strong and widespread among professionals" (Friedson, 1970: 81).

34. There is an interesting bit of information in the distribution on "professions considered" among those interviewees who expressed a willingness to consider changing their profession (Table 39N).

TABLE 39N

DISTRIBUTION OF INTERVIEWEES WILLING TO CONSIDER CHANGING THEIR PROFESSION BY PROFESSIONS THEY WOULD CONSIDER CHANGING TO

Professions Considered	Respondents	
	N	%
Medicine	7	38.8
Applied science	4	22.2
Public service	2	11.1
Manual labor	1	5.6
Other	3	16.7
Not certain	1	5.6
Total	18	100.0

Note especially that seven of the 18 respondents picked "medicine," and that 13 of the 18 respondents picked an "applied" or service field. This is interesting to note in terms of the usual definition of science as a profession, and of professions as service-oriented. For these scientists, the service in basic science was too amorphous for them to relate to, though none challenged the premise on a general level (e.g., as part of an ideology). They said they felt they could be doing something more to help people.

35. The problem of "norms" appears to be something more than one of "conflict and consensus." Merton's "paired-norms" hypothesis (1963), for example (i.e., inconsistent paired-norms are present in all social institutions) is not adequate to the task of explaining the function of the specific set of norms termed "norms of science." That function appears to operate independently of the general norm-conflicts associated with all social institutions.

36. Hagstrom's discussion of ideology in science is typical of one way of using the concept ideology with reference to science. Thus, he notes first that "Every established discipline possesses an ideology, a more or less explicit justification of its privileges and the claims it makes upon the scientific world and the larger society." But this leads him to focus on the articulation of established disciplines "with groups and organizations in their environments, and their ideologies are restricted in scope and oriented to specific audiences, primarily within science and scientific organizations" (1965: 211-212). I have, in contrast, focused specifically on ideology in science as a social system in relation to other social systems, and to society at large. Dibble's thesis (1962: 230) that (1) "higher ranking occupations are more likely to have highly developed ideologies" and (2) the ideologies of higher ranking occupations are likely to be less parochial than the ideologies of lower ranking occupations, is suggestive. Such ideologies function as systems of justification and explanation for the individual in terms of self (I'm doing the right thing for myself) and in terms of society (I'm doing the right thing for society). The ideology of science is not parochial--it does, in Dibble's terms, "include ideas which are relevant to the concerns of laymen entirely apart from their dealing with the occupation in question." But it is not clear that Dibble recognizes the "myth-functional" nature of this ideology, and the extent to which it offers reasons for not behaving with reference to "laymen."

37. This is important especially in the context of the basic research orientation of the universities: Hirsch (1968: 53) refers to the U.S. university as a "citadel of

basic research," with a monopoly in training and professional certification of scientists. The conclusion is that "basic science" is "closely tied to the vocabulary and needs of the body politic," an uncomfortable conclusion until one recognizes the impact of ideologicalization on science.

38. Cf. Mumford (1962: 134) and Hampden-Turner (1970: 31-65).

39. Mr. Vanderpool arrived at a definition of post-modernity which deviates significantly from my own definition: he writes, "The basic result of the post-modern society . . . is the transformation of society and the world. The direction of the transformation for some authors is towards the creation of a world community of man. For others, the post-modern world entails the proliferation of 'garrison states' or technocratic societies. In either case, the post-modern society is end fixated, the end being either the liberation of mankind and the realization of all human capabilities or the growth of technocracy and bureaucracy in a 'military-industrial state'" (1971: 33). Mr. Vanderpool thus includes in his definition of post-modern the technocratic-bureaucratic characteristics of the post-historic society. The basic difference in definition accounts for the disparity in our conclusions--whereas I conclude that our respondents are modern in orientation, Mr. Vanderpool concludes that they are post-modern. Mr. Vanderpool's definition of post-modern is much like my definition of modern. His definition of post-modern mixes the post-modern and the post-historic models; my definition of post-modern is akin to Mumford's definition of world culture and World Man.

40. The following generalizations are based on Mr. Vanderpool's as well as my own interview experiences.

41. This response is that of a South African social psychologist. I think the implications of his statement transcend the specific context of my research. I will, however, restrict myself to noting simply that the respondent appeared rather tense when dealing with this question, and also gave the impression of being under a lot of pressure in the third-cultural setting working with scientists from a number of countries. The tension and conflict reflected the fact that he was associated with the apartheid policies of his home country. It is not unlikely that his response to the question manifests a conflict between values generated by the culture of South Africa and the values associated with social psychological training, and work in the third-cultural.

42. See footnote 8.

43. Hagstrom's study indicates that preprint distribution is more prevalent in physics, reprint distribution in biology, something we were not aware of when we constructed our questionnaire.

44. The IQV on this item = 92.5.

45. Cf. Levinson (1964: 301), who lists among his propositions about idea systems the following; Proposition II: "Consistency; individuals are relatively (though by no means entirely) consistent from one ideological domain to another in their tendency to think autocratically or democratically." This would certainly be relevant to considering the impact on an individual of internalizing an ideology in science which was "all-ervasive" in terms of its effects on his after-work life and tending toward dogmatic closure.

46. "International science," in contrast to "third-culture of science," emphasizes the autonomy of global science. The problems associated with the advancement of science for the sake of science and scientists on a global level have been noted, for example, by Ribeiro (1967: 343-381); she argues that scientists in Latin America are being subverted from "the task of national development and placed at the service of international science." See also Riggs (1964: Chapter 4, and especially 153ff), and Stone (1969: 1118).

47. The most recent example of loss of biological diversity to come to my attention is directly related to man's attempt to solve the problem of providing food for the world's population. The success of high-yield crops is creating tendencies toward single-crop societies (Scientific American, 1971: 54); the scale of modern societies makes such a possibility more significant in terms of potential for survival than it was for single-crop societies in the past (see also Stebbins, 1971; Dahlsten, 1971). The sociocultural and biological tendencies toward loss of diversity have been interpreted as signs of an epochally imminent global tragedy.

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APPENDICES

Appendix A

TABLE 60A

COUNTRIES GROUPED BY LEVELS OF HUMAN RESOURCES DEVELOPMENT ACCORDING TO COMPOSITE INDEX (FROM HARBISON AND MYERS, 1964: 33)

Level I, Underdeveloped

0.3	Niger
0.75	Ethiopia
1.2	Nyasaland
1.55	Somalia
1.9	Afghanistan
1.9	Saudi Arabia
2.2	Tanganyika
2.6	Ivory Coast
2.95	Northern Rhodesia
3.55	Congo
4.1	Liberia
4.75	Kenya
4.95	Nigeria
5.3	Haiti
5.45	Senegal
5.45	Uganda
7.55	Sudan

Level II, Partially Developed

10.7	Guatemala
10.7	Indonesia
10.85	Libya
14.2	Burma
14.5	Dominican Republic
14.8	Bolivia
15.25	Tunisia
17.3	Iran
19.5	China (Mainland)
20.9	Brazil
22.6	Colombia
22.7	Paraguay
23.15	Ghana
23.65	Malaya
24.3	Lebanon
24.4	Ecuador
25.2	Pakistan
26.8	Jamaica
27.2	Turkey
30.2	Peru
31.2	Iraq

Level III, Semiadvanced

33.0	Mexico
35.1	Thailand
35.2	India
35.5	Cuba
39.6	Spain
40.0	South Africa
40.1	Egypt
40.8	Portugal
47.3	Costa Rica
47.7	Venezuela
48.5	Greece
51.2	Chile
53.9	Hungary
53.9	Taiwan
55.0	South Korea
56.8	Italy
60.3	Yugoslavia
66.5	Poland
68.9	Czechoslovakia
69.8	Uruguay
73.8	Norway

Level IV, Advanced

77.1	Denmark
79.2	Sweden
82.0	Argentina
84.9	Israel
85.8	West Germany
88.7	Finland
92.9	U.S.S.R.
101.6	Canada
107.8	France
111.4	Japan
121.6	United Kingdom
123.6	Belgium
133.7	Netherlands
137.7	Australia
147.3	New Zealand
261.3	United States

Appendix B

THE INDEX OF QUALITATIVE VARIATION

The IQV is based on "the total number of differences among the items in [a] given set" (Mueller and Schuessler, 1961: 177). In using the IQV, I set a homogeneity-heterogeneity cut-off at 75.0 percent. The cut-off was established by inspecting the way in which the index varies between 0 and 100 percent for various N's in the case of two- and three-item sets. I set the cut-off relatively high, taking into consideration the exploratory nature of my study and of these procedures, and my objective of emphasizing the direction of percentage differences. With an N of 200, for example, and a two-item set (e.g., a Yes-No response item), if the responses are distributed 160 and 40, the IQV = 64.0 percent. I thus set the cut-off to indicate the significant tendency to homogeneity represented by, for example, a 160 to 40 distribution of responses to a two-item set. Note that the same proportion distribution for smaller N's gives the same IQV, i.e., the IQV for a distribution, 80-20, 40-10, 20-5 equals in each case the IQV for the 160-40 distribution used above, 64.0 percent.

Appendix C

INTERVIEW SCHEDULE

A STUDY IN THE SOCIOLOGY OF SCIENCE

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East Lansing, Michigan

FACE SHEET

1. Sex: M_____ F_____
2. Age: _____
3. Marital Status: S_____ M_____ D_____ W_____
4. Number of children: _____
5. Birthplace: ______________________________
6. Citizenship: ______________________________
7. Current Position: Visiting_____ Nonvisiting_____

    _____ Instructor ____ Professor

    _____ Ass't. Professor ____ Research Assoc.

    _____ Assoc. Professor ____ Other (specify)__________

8. Field: ______________________________
9. Educational Background:

	Country	Field	Degree & Year
A. UNDERGRADUATE:	________	________	________
B. GRADUATE:	________	________	________
	________	________	________
C. POST-GRADUATE	________	________	________

10. Career History for LAST FIVE YEARS:

    A. Organization: _____ Industry

    _____ Government

    _____ University

    _____ Other (specify) __________

    B. Countries: __________ __________ __________

    C. Positions: __________ __________ __________

11. IF MARRIED: Background of Spouse:

    A. CITIZENSHIP: ______________________________

    B. BIRTHPLACE: ______________________________

    C. OCCUPATION: ______________________________

12. Background of Mother:

    A. CITIZENSHIP: ______________________________

    B. BIRTHPLACE: ______________________________

    C. OCCUPATION: ______________________________

13. Background of Father:

    A. CITIZENSHIP: ______________________________

    B. BIRTHPLACE: ______________________________

    C. OCCUPATION: ______________________________

14. Not counting this trip, what foreign countries have you visited in the last five years for reasons related to your work?

COUNTRY	LENGTH OF STAY
____________________	________________
____________________	________________
____________________	________________

15. IF MARRIED: Is your wife with you? YES ___ NO ___

16. IF MARRIED: Are your children with you? YES___ NO___

17. Do you interact regularly with foreigners in your home country?

    YES____ NO____ IF NO, GO TO 21

    18. WHAT COUNTRIES WERE THEY FROM?

    19. WHAT WERE THEIR OCCUPATIONS?

    20. WHY DID YOU INTERACT WITH THEM?

21. IF RESPONDENT HAS CONTACTED SCIENTISTS; WHAT WERE YOUR OBLIGATIONS AND RESPONSIBILITIES TO THEM?

22. How did you happen to come to this country?

A. To do research with colleagues ______
B. To learn about new techniques ______
C. To see America ______
D. To communicate results with colleagues ______
E. To do research which could not be done at home ______
F. To teach ______
G. Other (specify)

____

23. How did you happen to come to this university?

A. I was invited by colleagues ______
B. Invitation by university ______
C. University provided funds to do what I want to do ______
D. A friend of mine was here before ______
E. Exchange program ______
F. Other (specify)

____

24. What do you plan to do after your stay here?

25. WHY?

26. Who provided the financial support for your trip here at this time?

	Home Country	U.S.	Other
A. Government:	_____	_____	_____
B. Industry:	_____	_____	_____
C. Foundation:	_____	_____	_____
D. University:	_____	_____	_____
E. U.N. Agencies:	_____		
F. Other (specify):			

____

27. Who supports your work here?

WORK ROLE

28. On this sheet are a list of activities scientists sometimes perform. CHECK THOSE ACTIVITIES YOU PERFORM BACK HOME. (GET RANK ORDER)

29. WHICH ACTIVITIES TOOK UP MOST OF YOUR TIME? (GET RANK ORDER)

30. Here is a sheet identical to the one I just gave you. CHECK THOSE ACTIVITIES WHICH YOU PERFORM HERE. (GET RANK ORDER)

31. WHICH ACTIVITIES TAKE UP MOST OF YOUR TIME HERE? (GET RANK ORDER)

32. Which of the above activities do you regard as most central to your role as a FIELD?

    ____

33. Which of the above activities are most central to FIELD in your home country?

    ____

34. Which of the above activities are most central to FIELD in the United States?

    ____

35. What types of activities will you perform when you go back home?

    A. The same as before ____
    B. The same as here ____
    C. Different (specify)

    ____

36. As a result of this trip to the United States, do you plan to change the way you perform your activities?

    _____ YES _____ NO IF NO, GO TO 39.

    37. IN WHAT WAYS WILL YOU CHANGE YOUR ACTIVITIES?

    38. DO YOU PLAN TO CONTINUE TO WORK IN THE SAME FIELD?

39. What are the networks of exchanges between American and H.C. Field?

    A. Jobs ____
    B. Money ____
    C. Resources ____
    D. Journals ____
    E. Equipment ____
    F. Students ____
    G. News and gossip ____
    H. Work contacts with other scientists ____

    (PROBE FOR DIRECTION OF EXCHANGES)

WORK ROLE HOME COUNTRY

1. Teaching formal courses and seminars (including preparation time) ______
2. Basic research ______
3. Applied research ______
4. Research and development ______
5. Teaching-research (that kind of research carried on with one or more apprentice researchers for whom this research involvement is part of their formal training ______
6. Administration within an organization ______
7. Public service activities (speaches to general public, appearances on T.V. and radio, popularization of science, representing your field at civil functions, etc.) ______
8. Consultant to public organizations ______
9. Consultant to private organizations ______
10. Organizational activities in science (editing, membership participation, committee participation in scientific organizations, etc.) ______
11. Writing and publication ______
12. Other (specify) ________________________________

WORK ROLE UNITED STATES

1. Teaching formal courses and seminars (including preparation time) _____

2. Basic research _____

3. Applied research _____

4. Research and development _____

5. Teaching-research (that kind of research carried on with one or more apprentice researchers for whom this research involvement is part of their formal training) _____

6. Administration within an organization _____

7. Public service activities (speaches to general public, appearances on T.V. and radio, popularization of science representing your field at civil functions, etc.) _____

8. Consultant to public organizations _____

9. Consultant to private organizations _____

10. Organizational activities in science (editing, membership participation, committee participation in scientific organizations, etc.) _____

11. Writing and publication _____

12. Other (specify) ____

TEACHING WORK ROLE
IF THE RESPONDENT HAS TAUGHT BEFORE
AND IS CURRENTLY TEACHING, ADMINISTER
THE FOLLOWING QUESTIONS

1. What level courses are you teaching?

2. What are the differences you have experienced in teaching here as compared to eaching in your home country?

3. What do you like most about teaching here?

4. What do you like least?

5. In your field, when does a man reach his peak as a teacher?

6. What impact does teaching have on your professional career, e.g., is it detrimental to your status in the field, etc.?

    7. DOES THIS VARY IF YOU TEACH IN YOUR HOME COUNTRY AS COMPARED TO TEACHING IN THE UNITED STATES?

    IF YES:

    8. IN WHAT WAYS:

9. Is there a difference in the way you teach ___________ (field)

Here as compared to your home country?

(Probe for materials added to a course which are not part of the general subject matter of the course.)

40. WHAT IS YOUR ROLE IN THESE NETWORKS?

(PROBE FOR OBLIGATIONS IN PROFESSIONAL COMMUNITY)

41. Have you interacted with students in your home country?
YES ____ NO ____ IF NO, GO TO 44.

42. DO YOU FIND THAT THERE IS A DIFFERENCE IN THE WAY YOU INTERACT WITH STUDENTS HERE AS COMPARED TO YOUR INTERACTION WITH STUDENTS BACK HOME?
YES ____ NO ____ IF NO, GO TO 44.

43. WHAT IS THE NATURE OF THE DIFFERENCE?

44. Do you find that there is a difference in the way you interact with persons in authority positions here (e.g., Dept. chairman, Deans, etc.) as compared with the way you interact with similar individuals back home?
YES ____ NO ____ IF NO, GO TO 46.

45. WHAT IS THE NATURE OF THE DIFFERENCE?

46. In your current stay here who are the nationals you most frequently interact with?

47. WHAT DO YOU USUALLY TALK ABOUT?

a. work (research) ____
b. social matters ____
c. other (specify) ____

48. Did you know these scientists personally before you came to this country? YES ____ NO ____
IF NO, GO TO 51.

49. HOW DID YOU GET TO KNOW THEM?

50. HOW WELL DO YOU KNOW THEM?

51. Some individuals are completely involved in their research--absorbed by it night and day. For others their work is simply one of several interests. IN YOUR HOME COUNTRY, HOW INVOLVED WERE YOU IN RESEARCH?

Completely involved ____ Somewhat involved ____
Not much involved ____

52. Has the level of your work involvement changed since you've been here?

53. Is there anything about your work experiences here which you did not expect before coming here?
YES ____ NO ____ IF NO, GO TO 55.

54. WHAT DIDN'T YOU EXPECT?

55. Are the work habits of your American colleagues different from the work habits of your colleagues back home?
YES ____ NO ____ IF NO, GO TO 57.

56. IN WHAT WAYS ARE THEY DIFFERENT?

57. What do you like most about working with Americans?

58. What do you like least about working with Americans?

COMMITMENT TO SOCIAL CHANGE

59. Are you involved in bringing about change in your country?
YES ____ NO ____ IF NO, GO TO 65.

60. What type of change are you working for?

61. Why are you involved?
a. It is my duty to my country ____
b. Every scientist must ____
c. To better mankind ____
d. My work role necessitates it ____
e. It's an opportunity for advancement ____
f. Other (specify) ________________

62. What is the nature of your involvement?
a. Membership in political groups ____
b. Applied research ____
c. Planning groups ____
d. Basic research ____
e. Teaching ____
f. Consulting ____
g. Kinship and friendship groups ____
h. Other (specify) ________________

63. Are there any constraints placed on your involvement?
YES ____ NO ____ IF NO, GO TO 66.

64. WHAT ARE THESE CONSTRAINTS AND WHO IMPOSES THEM?

A. Constraints:

a. Social values cannot be investigated ___
b. Cannot attack groups in power ___
c. Cannot criticize ideology ___
d. Cannot investigate certain physical problems ___
e. Illegal to pursue these activities ___
f. Other (specify) ___

____

B. Imposers:

a. Public in general ___
b. Government and other authorities ___
c. Religious groups ___
d. Traditional leaders ___
e. Other (specify) ___

____

GO TO 66

65. Why aren't you involved?

a. Outside the role of a scientist ___
b. Too involved in my work to bother with it ___
c. Fear the reprisals of such involvement ___
d. Cannot because others prevent me ___
e. Other (specify) ___

____

IF RESPONDENT ANSWERS WITH STATEMENTS SIMILAR TO c. & d., PROBE THE CONSTRAINTS AND THE IMPOSERS OF CONSTRAINTS.

66. How do you feel about scientists who are directly involved in bringing about change in your society?

IMAGES OF THE FUTURE

67. If you could picture your country in the best possible form, how would things look about ten years from now?

68. What models do you use to construct this ideal picture of your country?

69. What segments of your society share such models?

70. Are the scientists in your country important for achieving this future?

71. Do you think this ideal future will be achieved by your country? YES ____ NO ____

72. IF NO: WHY NOT?

73. IF YES: WHY?

74. Are you pessimistic or optimistic about the future of the world? PESSIMISTIC ___ OPTIMISTIC ___

75. WHAT IS THE BASIS OF YOUR PESSIMISM OR OPTIMISM?

SOCIAL RESPONSIBILITY

76. Some scientists are concerned about the effects of their work on society (e.g., the atomic scientists who expressed concern about the use of atomic weapons, biologists who are concerned about indiscriminate crop spraying). Other scientists are not concerned (e.g., mathematicians working on theoretical problems which have no applied aspects). Are you concerned about the effects of your work on society?

YES ____ In what way?

NO ____ Why not?

IF YES, GO TO PROBE 77. IF NO, GO TO 78.

78. Are you a member of any associations or group of scientists interested in the effects of scientific research on society?

YES ____ (names of organizations)

NO ____

IF NO, GO TO 79.

79. Would you be interested in joining such an organization? WHY OR WHY NOT?

KINSHIP

80. How have your family and relatives influenced your professional career?

ORGANIZATIONAL PARTICIPATION

81. What scientific organization do you belong to?

82. Is there a viable scientific association in your field in your home country?

83. What are the goals of the scientific organizations you belong to?

84. WHAT ARE THEIR SOCIETAL FUNCTIONS?

85. How often do you attend meetings at the:

	very often	often	seldom	never
a. Regional level	___	___	___	___
b. National level	___	___	___	___
c. International level	___	___	___	___

86. What meetings have you attended in the U.S.?

87. WHY DO YOU ATTEND THESE MEETINGS?

a. To meet old friends ___
b. To establish new relations ___
c. To advance my career ___
d. To meet with other people doing the same research ___
e. To advance the career of students ___
f. To keep up with developments of the field ___
g. Other (specify) ______________________________

88. WHAT LANGUAGES ARE USED AT THE INTERNATIONAL MEETINGS YOU HAVE ATTENDED?

89. How would your colleagues describe your role in the profession?

90. How many papers have you published in journals?
1-10 ___ 11-20 ___ Over 20 ___ None ___

91. Where do you usually publish?

92. WHY DO YOU PUBLISH IN THESE PLACES?

93. In what languages do you write for publication?

94. HAS YOUR WORK BEEN TRANSLATED INTO OTHER LANGUAGES?

95. DO YOU TRANSLATE PUBLISHED WORKS?

96. Who reads what you publish?

97. To whom would you send preprints and reprints of your articles? PROBE FOR COUNTRY.

98. How many books have you published?
1-5 ___ 6-10 ___ Over 10 ___ None ___

99. Have you published papers and books in subjects other than your own? YES ___ NO ___ IF NO, GO TO 101.

    100. IN WHAT AREAS?

THIRD CULTURAL RELATIONS

101. Have scientific gatherings in nations other than your home country enabled you to establish personal and communication ties with scientists from other nations? YES ___ NO ___ IF NO, GO TO 108.

    102. WHERE WERE THEY HELD?

    103. WHAT LANGUAGES WERE SPOKEN?

    104. WHAT NATIONS DID THE SCIENTISTS COME FROM?

    105. HOW DO YOU KEEP IN TOUCH?
    a. Letters ___
    b. Visits ___
    c. Other meetings ___
    d. Other (specify) ______________________________

    106. WHAT DO YOU USUALLY TALK ABOUT?

    107. HOW WELL DO YOU KNOW THEM?

    GO TO 109.

108. How do you establish such relationships?

109. Do you ever visit a country specifically to meet with scientists in your field?

110. When visiting another country, do you look up scientists in your field? YES ___ NO ___ IF NO, GO TO 112.

    111. WHY?

112. Have any of the scientists you met abroad visited you here in the U.S.? YES ___ NO ___ IF NO, GO TO 116.

    113. WHY?

    114. WHAT WERE YOUR OBLIGATIONS AND RESPONSIBILITIES TO THEM?

    115. WHAT COUNTRIES WERE THEY FROM?

116. In your relations with foreign scientists, is your national identity a liability or an asset?
   a. Liability ____
   b. Asset ____
   c. Both ____
   d. Doesn't make a difference ____
   e. Don't know ____ IF e., GO TO 124.

117. WHY?

118. DOES THIS PROBLEM ARISE WITH SCIENTISTS FROM CERTAIN NATIONS? YES ____ NO ____ IF NO, GO TO 122.

   119. WHICH NATIONS?

   121. WHY?

122. DOES THIS HAVE ANY AFFECT ON YOUR CAREER PLANS? YES ____ NO ____ IF NO, GO TO 124.

   123. WHAT AFFECT?

COGNATIVE MAP

124. What are the essential characteristics of a science? ALTERNATE: WHAT DISTINGUISHES THE SCIENCES FROM OTHER SUBJECTS, FOR EXAMPLE, FROM LITERATURE, OR ART, OR PHILOSOPHY?

125. Which are the leading countries in your field?

126. HOW WOULD YOU RANK THESE COUNTRIES?

IF HOME COUNTRY IS NOT MENTIONED IN 125, PROBE 127--OTHERWISE GO TO 128.

   127. WHAT ABOUT YOUR HOME COUNTRY? IS IT AMONG THE LEADERS, CLOSE BEHIND, LAGGING FAR BEHIND, OR NOT IN THE PICTURE AT ALL?

128. Has there been any change in the position of your home country during the past decade? YES ____ NO ____ IF YES, PROBE 129. IF NO, GO TO 130.

   129. HOW HAS IT CHANGED?

130. Do you anticipate any change in the position of your home country in the foreseeable future? YES ___ NO ___

   131. WHY OR WHY NOT?

132. If you had an outstanding student which country would you send him to for the best possible professional training in your field?

133. Which are the leading journals in your field?

134. WHICH COUNTRIES ARE THEY PUBLISHED IN?

135. Is there any country--or are there any countries--which makes it difficult or impossible for you to learn what its scientists in your field are doing? YES ____ NO ____ IF YES, PROBE 136, 137. IF NO, GO TO 138.

136. WHICH COUNTRY(IES)?

137. WHY IS IT DIFFICULT OR IMPOSSIBLE TO LEARN WHAT SCIENTISTS IN THIS COUNTRY(IES) ORE DOING?

138. Is there any country(ies) whose scientists you would not share your work with? IF YES, PROBE 139, 140. IF NO, GO TO 141.

139. SHICH COUNTRY(IES)?

140. WHY WOULDN'T YOU SHARE YOUR WORK?

141. Are there any conditions under which you would not share your work with scientists in another country (ies)? YES ____ NO ____ IF YES, PROBE 142. IF NO, GO TO 143.

142. WHAT CONDITIONS?

143. In evaluating a scientific statement, journal article, etc. by a scientist in your field do you ever take into account the fact that he is from a particular country--does his nationality affect your evaluation in any way? YES ____ NO ____ IF YES, PROBE 144. IF NO, GO TO 145.

144. HOW DOES THIS ENTER INTO YOUR EVALUATION?

145. Think of all the countries you have worked in and all the scientists you have worked with. Which country's scientists would you most prefer to work with? IF PREFERENCE EXPRESSED, PROBE 146. IF NO PREFERENCE, GO TO 147.

146. WHY?

147. Which country's scientists would you most prefer to socialize with? IF PREFERENCE EXPRESSED, PROBE 148. IF NO PREFERENCE, GO TO 149.

148. WHY?

149. Which persons outside of your field do you consider to be part of your audience--persons you want to share your knowledge with in one way or another? IF NONE, GO TO 153. OTHERWISE, PROBE 150, 151, 152.

    150. PROBE NATIONAL, BI-NATIONAL, MULTI-NATIONAL, INTERNATIONAL.

    151. WHICH SEGMENTS IN SOCIETY DO THEY REPRESENT?

    152. WHY DO YOU WANT TO INCLUDE THEM IN YOUR AUDIENCE?

153. Which persons outside of your field would you explicitly exclude from your audience? IF NONE, GO TO 151. OTHERWISE, PROBE 154, 155, 156.

    154. PROBE NATIONAL, BI-NATIONAL, MULTI-NATIONAL, INTERNATIONAL.

    155. WHICH SEGMENTS IN SOCIETY DO THEY REPRESENT?

    156. WHY DO YOU WANT TO EXCLUDE THEM FROM YOUR AUDIENCE?

157. How many persons in your field are there in your home country?

    158. HOW MANY DO YOU KNOW PERSONALLY?

159. Does it make any difference to you what country you <u>work</u> in? YES ____ NO ____

    160. WHY OR WHY NOT?

161. Does it make any difference to you what country you <u>live</u> in? YES ____ NO ____

    162. WHY OR WHY NOT?

163. Think of the best possible conditions for carrying out the work you are interested in. Is there any one country (or countries) in which you would be able to work under approximately such conditions?

164. Are there any limits placed on the kind of work you can do in your home country? IF YES, PROBE 165. IF NO, GO TO 166.

    165. WHAT KINDS OF LIMITS?

166. Are there any limits placed on the kind of work you can do here? IF YES, PROBE 167. IF NO, GO TO 168.

167. WHAT KINDS OF LIMITS?

168. Are there any other persons from your home country in this department? YES ____ NO ____ DON'T KNOW ____ IF YES, PROBE 169. IF NO OR DON'T KNOW, GO TO 173.

170. DO YOU KNOW THEM PERSONALLY? YES ____ NO ____ KNOW SOME ____ IF YES, OR KNOW SOME, PROBE 171. IF NO, GO TO 172.

171. WHAT DID YOU TALK ABOUT THE LAST TIME YOU GOT TOGETHER WITH SOME OR ALL OF THEM?

172. Are there any other persons from your home country at this university? YES ____ NO ____ DON'T KNOW ____ IF YES, PROBE 173. IF NO, OR DON'T KNOW, GO TO 175.

173. DO YOU KNOW THEM PERSONALLY? YES ____ NO ____ KNOW SOME ____ IF YES, OR KNOW SOME, PROBE 174. IF NO, GO TO 175.

174. WHAT DID YOU TALK ABOUT THE LAST TIME YOU GOT TOGETHER?

175. Are there any other persons from your home country in your field visiting in the United States? YES ____ NO ____ DON'T KNOW ____

176. When you retire, or nearing the end of your career, what would you like people in general to remember you for?

177. WHICH PERSONS WOULD YOU LIKE TO BE REMEMBERED BY IN PARTICULAR?

178. Some scientists believe that the criteria for truth and verification in science will never change. Do you agree with them? YES ____ NO ____

179. WHY OR WHY NOT?

180. What would you say are the most productive years for a scientist in your field?

181. If you could change your profession today, would you? IF YES, PROBE 182. IF NO, PROBE 183.

182. WHAT WOULD YOU CHANGE TO, AND WHY?

183. WHY NOT?

IF RESPONDENT HAS BEEN ABROAD BEFORE ASK QUESTIONS 184, 185, 186. IF THIS IS HIS FIRST TRIP ABROAD, GO TO 187.

184. Upon returning to your home country did you (or do you usually) discuss your visit with people in your field? YES ____ NO ____ IF YES, PROBE 185. IF NO, PROBE 186.

185. WHY?

186. WHY NOT?

187. Have you tried to arrange for one or more of your colleagues and/or students to visit abroad? YES ___ NO ____

188. Have you tried to arrange visits to your home country for scientists you met abroad? YES ____ NO ____

189. For each of the following types of scientists indicate the extent to which you feel you have something in common with them by virtue of being a scientist.

Physical scientists

GREAT DEAL IN COMMON ____ SOMETHINGS IN COMMON ____
A FEW THINGS IN COMMON, BUT NOT MANY ____
NOTHING AT ALL IN COMMON ____

Biological scientists

GREAT DEAL IN COMMON ____ SOMETHINGS IN COMMON ____
A FEW THINGS IN COMMON, BUT NOT MANY ____
NOTHING AT ALL IN COMMON ____

Social scientists

GREAT DEAL IN COMMON ____ SOME THINGS IN COMMON ____
A FEW THINGS IN COMMON, BUT NOT MANY ____
NOTHING AT ALL IN COMMON ____

190. Of the following, which best characterizes your present work?

a. Specifically related to physical and/or biological problems indigenous to my home country ____

b. Specifically related to economic, social, and/or political problems of my home country ____

c. Specifically related to physical and/or biological problems indigenous to a specific region (e.g., Southeast Asia) ____

d. Specifically related to economic, social, and/or political problems of a specific region (e.g., Southeast Asia) ____

e. Specifically related to physical and/or biological problems affecting the world as a whole ____

f. Specifically related to economic, social and/or political problems which involve all nations ___

g. Has no relationship to national or geographic boundaries ____

191. On the basis of your response to the last question, what effect does the character of your work have on the nature of your career, if any? Is it an asset, a liability, or irrelevant to getting ahead in your field, making a name or reputation, etc.?

PROBE FOR CAREER REFERENT--HOME COUNTRY, UNITED STATES, INTERNATIONAL SCIENTIFIC COMMUNITY . . .

GENERATIONS

192. How many generations can you identify in your field in your home country? PROBE FOR REFERENT: IS IT SOCIETAL, OR SCIENTIFIC?

193. Which generation do you belong to?

194. Are there any significant differences between the generations you have identified?

PROBE FOR COMMITMENT TO BUILDING A SCIENTIFIC COMMUNITY (NATIONAL, BI-NATIONAL, MULTINATIONAL OR INTERNATIONAL) AND CONCERN FOR PROBLEMS OF DEVELOPMENT, MODERNIZATION, AND POST-MODERNIZATION.

195. Do you feel any obligations to the next generation of scientists in your home country? YES ____ NO ____

196. WHY OR WHY NOT?

CONDITIONS OF WORK

197. During the last five years where have you spent most of your working hours?

    a. Laboratory ____
    b. Field ____ (social surveys, geological or geographic surveys, etc.)
    c. Clinic ____
    d. Library ____
    e. Office ____
    f. Other ____

    IF MORE THAN ONE OF THE ABOVE IS RELEVANT, RANK ORDER YOUR RESPONSES.

198. Indicate the extent to which each of the following has characterized your work over the last five years.

    a. Theoretical: Definitely characteristic ___ Somewhat characteristic ___ Not characteristic __

    b. Methodological: Definitely characteristic ___ Somewhat characteristic ___ Not characteristic ____

    c. Experimental: Definitely characteristic ___ Somewhat characteristic ___ Not characteristic __

    d. Technological (including applied work, research and development, etc.): Definitely characteristic ____ Somewhat characteristic ____ Not characteristic ____

    e. Clinical: Definitely characteristic ___ Somewhat characteristic ___ Not characteristic __

    f. Descriptive: Definitely characteristic ___ Somewhat characteristic ___ Not characteristic __

199. During the last five years, how many people have you usually worked with on each of your studied?
    IF RESPONDENT HAS WORKED ALONE, GO TO 201. OTHERWISE, PROBE 200.

    200. WHAT KIND OF RELATIONSHIP DID YOU HAVE WITH THE PERSON(S) YOU WORKED WITH--WERE THEY COLLEAGUES, TECHNICIANS, SUPERVISORS . . .?

201. What would you say are the most important tools and resources in your work--things you must have in order to carry out your research?

202. How well organized is your field in terms of a body of empirically corroborated hypotheses, systematic theories, etc.?

203. Some scientists are working on the forefronts of knowledge, in fields or subfields that are just beginning to receive attention; others are involved in research that is peripheral to the main concerns of men in their field; still other scientists may fit somewhere between these two extremes. How would you characterize your work with reference to your field in general?

204. To what extent does your work entail financial costs requiring large-scale funding (e.g., government funding)?

COMMUNITY AND PUBLIC ACTIVITIES (REFERENT IS HOME COUNTRY UNLESS OTHERWISE SPECIFIED)

205. Have you been involved in any non-scientific organizations or activities (for example, as an elected public official, a public lecturer, a civic leader, etc.) at the local level (e.g., in your community) during the last five years? IF YES,PROBE 206-216. IF NO, PROBE 217.

    206. WHAT ACTIVITIES AND ORGANIZATIONS, AND IN WHAT CAPACITY?

    207. ARE YOU STILL INVOLVED IN THESE ACTIVITIES AND ORGANIZATIONS?

    208. DO YOU INTEND TO REMAIN INVOLVED?

    209. WHEN YOU ARE ENGAGED IN THESE ACTIVITIES DO YOU THINK OF YOURSELF PRIMARILY AS A /respondent's field/, A SCIENTIST, A CITIZEN . . .?

    210. DO OTHERS THINK OF YOU IN THE SAME WAY?

    211. WHAT DO COLLEAGUES IN YOUR FIELD THINK ABOUT YOUR PARTICIPATION IN THESE ACTIVITIES?

    212. WHY DO YOU ENGAGE IN THESE ACTIVITIES?

    213. BY VIRTUE OF BEING A SCIENTIST, IS THERE ANYTHING THAT ESPECIALLY QUALIFIES YOU TO ENGAGE IN THESE ACTIVITIES? YES ____ NO ____ IF YES, PROBE 214. IF NO, GO TO 215.

    214. WHAT IN PARTICULAR?

215. WHEN PARTICIPATING IN THESE ACTIVITIES DO YOU THINK OF YOURSELF AS A REPRESENTATIVE OF A SPECIFIC GROUP OR ORGANIZATION, FOR EXAMPLE THE SCIENTIFIC COMMUNITY, YOUR HOME COUNTRY . . .?

216. WHAT IMPACT, IF ANY, HAS YOUR PARTICIPATION IN THESE ACTIVITIES HAD ON YOUR PROFESSIONAL CAREER?

GO TO 218.

217. WHY AREN'T YOU ENGAGED IN SUCH ACTIVITIES?

218. Do you think scientists in general should become involved in the kinds of activities we have been discussing? YES ___ NO ___

219. WHY OR WHY NOT?

220. Have you participated in decision-making at the national level during the last five years? YES ____ NO ____ IF YES, PROBE 221-231. IF NO, PROBE 232.

221. WHAT ACTIVITIES IN PARTICULAR, AND IN WHAT CAPACITIES?

222. ARE YOU STILL INVOLVED IN THESE ACTIVITIES?

223. DO YOU INTEND TO REMAIN INVOLVED?

224. WHEN YOU ARE ENGAGED IN THESE ACTIVITIES DO YOU THINK OF YOURSELF PRIMARILY AS A /respondent's field/, A SCIENTIST, A CITIZEN . . .?

225. DO OTHERS THINK OF YOU IN THE SAME WAY?

226. WHAT DO COLLEAGUES IN YOUR FIELD THINK ABOUT YOUR PARTICIPATION IN THESE ACTIVITIES?

227. WHY DO YOU ENGAGE IN THESE ACTIVITIES?

228. BY VIRTUE OF BEING A SCIENTIST, IS THERE ANYTHING THAT ESPECIALLY QUALIFIES YOU TO ENGAGE IN THESE ACTIVITIES? YES ____ NO ____ IF YES, PROBE 229. IF NO, GO TO 230.

229. WHAT IN PARTICULAR?

230. WHEN PARTICIPATING IN THESE ACTIVITIES DO YOU THINK OF YOURSELF AS A REPRESENTATIVE OF A SPECIFIC GROUP OR ORGANIZATION, FOR EXAMPLE, THE SCIENTIFIC COMMUNITY, YOUR HOME COUNTRY . . .?

231. WHAT IMPACT, IF ANY HAS YOUR PARTICIPATION IN THESE ACTIVITIES HAD ON YOUR CAREER?

GO TO 233.

232. WHY AREN'T YOU ENGAGED IN SUCH ACTIVITIES?

233. Do you think scientists in general should become involved in the kinds of activities we have been discussing? YES ____ NO ____

234. Looking over all your experiences here, in other countries and back home, what effect have they had on the way you view man, society and the world?

235. Are there any questions I did not ask which I should have asked?

INTERVIEWER'S COMMENTS:

Appendix D

QUESTIONNAIRE

VISITING FOREIGN SCIENTISTS AND SCHOLARS: A STUDY IN THE SOCIOLOGY OF SCIENCE

Sal P. Restivo
C. K. Vanderpool
Department of Sociology
Michigan State University
Summer 1969

1. Sex: Male ____ Female ____

2. Age:

3. Marital Status: Single ____ Married ____
   Divorced ____ Widowed ____

4. Birthplace: ____________________

5. Citizenship: ____________________

6. Current Position: Visiting Instructor ____
   Visiting Assistant Professor ____
   Visiting Associate Professor ____
   Visiting Research Associate ____
   Other (specify) ____________

7. What is your field? ____________________

8. What are your areas of specialization? ____________

9. Indicate the academic degrees you have earned.

   Bachelors Degree (or equivalent): Year ____
   Country ____
   Subject ____

   Masters Degree (or equivalent): Year ____
   Country ____
   Subject ____

   Ph.D. (or equivalent) Year ____
   Country ____
   Subject ____

10. In the last five years, where have you been employed?

    a. Organization: Industry ____
       Government ____
       University ____
       Other (specify) ____________

    b. Country(ies) ____________________

    c. Position(s) ____________________

11. Not counting this trip to the U.S., what foreign countries have you visited in the last five years for reasons related to your work?

Countries	Length of Stays
____________	____________
____________	____________
____________	____________

12. Did you interact regularly with foreigners in your home country? Yes ____ No ____

13. Why did you come to this country? (Check as many as applicable).

    a. To do research with colleagues ____
    b. To learn about new techniques ____
    c. To do research which could not be done at home ____
    d. To teach ____
    e. Other (specify) ____________

14. How did you happen to come to this university? (Check as many as applicable).

    a. I was invited by American colleagues I met in my home country. ____
    b. I was invited by a colleague in the U.S. who knew of my work in my field. ____
    c. A former teacher recommended me for a position. ____
    d. Personal initiative. ____
    e. A friend of mine was here before. ____
    f. Other (specify): ____________

15. What do you plan to do after your stay here?

    a. Stay in the U.S. ____
    b. Return home. ____
    c. Not certain. ____
    d. Other (specify): ____________

16. What types of activities will you perform after you stay here?

    a. The same as before I left my home country ____
    b. The same as I perform here in the U.S. ____
    c. Other (specify) ____________

17. The following list is composed of activities scientists sometimes perform. Please rank each activity in terms of the amount of time and effort you expend in them while in your home country and now in the U.S. (For example, teaching 2 , Basic research 1 , Organizational activities 3 , etc.). If you haven't performed the activity, please leave the space blank.

	Home Country	U.S.
a. Teaching formal courses and seminars (including preparation time)	__________	______
b. Basic research	__________	______
c. Applied research	__________	______
d. Teaching-Research (that kind of research carried on with one or more apprentice researchers for whom this research involvement is part of their formal training)	__________	______
e. Administration within an organization	__________	______
f. Consultant to public and/or private organizations	__________	______
g. Organizational activities in science (editing, membership participation, committee participation, in science organization, etc.)	__________	______
h. Writing and publication	__________	______

i. Other (specify) ______________________________

18. Which of the following statements concerning teaching and a career in your field do you agree or disagree with?

Use the following rating: 1 = Strongly Agree; 2 = Agree; 3 = Neither agree, nor disagree; 4 = Disagree; 5 = Strongly disagree.

a. A combination of teaching and research helps a person in my field to be successful. ____
b. Teaching without an emphasis on research is detrimental to a career in my field. ____
c. Teaching detracts from time and effort that should be spent in research. ____

19. In terms of your ability to teach science, do you feel any obligation to or responsibility for the next generation of scientists in your home country?

Definitely _____ Somewhat _____ None _____

20. Comparing your experience here in the U.S. and back home, do you find that there is a difference between American students and students from your home country? Yes ____ No ____

    If Yes: What is the difference? ____________________

21. Do you find that there is a difference in the way you interact with persons in authority here (e.g., Department Chairmen, Deans, etc.) as compared with the way you interacted with similar individuals back home? Yes ____ No ____

    If Yes: What is the difference? ____________________

22. Has the level of your involvement in work changed since you've been here in the following ways?

    a. Working longer hours Yes ____ No ____
    b. Working less than before Yes ____ No ____
    c. More dedication to work Yes ____ No ____
    d. Other (specify): ____________________

23. Please indicate which of the groups below include most of the persons you work with.

    a. Americans 1) in my field ___
       2) not in my field ___
    b. Persons from my home country
       1) in my field ___
       2) not in my field ___
    c. Persons from other countries
       1) in my field ___
       2) not in my field ___

24. Please indicate which one of the groups below includes most of the friends you see socially, i.e., away from work.

    a. People in my field who work where I do and are from
       1) the United States ___
       2) my home country ___
       3) other countries ___

    b. People in my field who work elsewhere and are from
       1) the United States ___
       2) my home country ___
       3) other countries ___

c. People not in my field who work where I do and are from
   1) the United States ___
   2) my home country ___
   3) other countries ___

d. People not in my field who work elsewhere and are from
   1) the United States ___
   2) my home country ___
   3) other countries ___

25. Indicate the extent of your agreement or disagreement with the following statements. Use the following rating: 1 = Strongly agree; 2 = Agree; 3 = Neither agree nor disagree; 4 = Disagree; 5 = Strongly disagree.

   a. Americans in my field work harder than my colleagues back home. ____
   b. My colleagues back home work longer hours than their American counterparts. ____
   c. Americans are not as dedicated to their work as my home country colleagues. ____
   d. The degree of understanding that Americans have of the problems confronting my field ____
   e. Americans are more organized in their work than my colleagues back home. ____

26. Please indicate the extent to which each of the following has been a part of your scientific work over the past five years.

   a. Theory construction: great part __ some part __ no part __
   b. Mathematics and Statistics: great part __ some part __ no part __
   c. Methodology: great part __ some part __ no part __
   d. Experimentation: great part __ some part __ no part __
   e. Clinical work: great part __ some part __ no part __
   f. Engineering: great part __ some part __ no part __

27. How important is each of the folliwng in determining your choice of a research problem to work on?

    a. Problems facing mankind (e.g., world population crisis, international conflicts)
    very important __ somewhat important __
    not at all important __
    b. Problems facing my home country (e.g., economic development, problems in education)
    very important __ somewhat important __
    not at all important __
    c. Scientific problems (e.g., theory, methodology)
    very important __ somewhat important __
    not at all important __

28. What do you consider as the single most important factor affecting your choice of a research problem?

    ____

29. Do you feel a sense of responsibility for the possible social consequences of your research?
    Definitely __ Somewhat __ Not at all __

30. How do you think the research you are doing will affect mankind?
    a. will definitely be of great benefit ___
    b. will definitely have adverse effects ___
    c. will definitely have no effect on society in the foreseeable future ___

31. Some scientists and scholars maintain that every scientist and scholar should be directly involved in the decision-making process of their country. Do you agree or disagree with them?
    Strongly agree __ Agree __ Neither agree nor disagree __ Disagree __ Strongly disagree __

32. To what extent does your work entail financial costs requiring large-scale funding by major foundations or government agencies?

    to a great extent ___ to some extent ___ not at all __

33. During the last five years where have you spent most of your working hours? If more than one of the following categories is relevant, please clarify by rank ordering them in terms of the amount of time and effort you spent in each setting.

    a. Laboratory __ b. Field (social surveys, geological surveys) __ c. Clinic __ d. Library __
    e. Office __ f. Home __ g. Other (specify) __

    ____

34. Please list the leading countries in your field, in rank order if possible.

Leading Country(s)	____________	______________
2nd	____________	______________
3rd	____________	______________
4th	____________	______________
5th	____________	______________

35. If your home country is NOT mentioned in question 34, please answer this question: Where does your home country fit into the picture?
a. Among the leaders __ b. Close behind the leaders __ c. Lagging behind the leaders __ d. Not at all in the picture __

36. Do you anticipate any improvement in the position of your home country in the foreseeable future?
Yes __ No __

37. What country or countries are the scientists you most frequently communicate with from?

______________ ______________ ______________

38. How do you communicate with them? Rank order the following in terms of their importance as a means of communication.
a. Letters __ b. Telephone __ c. Associational meetings __ d. Pre-prints/reprints __ e. Personal visits __ f. Other (specify) ____________________

39. Is there any country (or countries) whose scientists and scholars it is difficult or impossible for you to communicate regularly and freely with?
Yes __ No ____

If yes: List the countries: ______________________

What prevents regular and free communication?
1) Language ___
2) Politics ___
3) Other (specify) ____________________________

40. Would you accept a permanent job outside of your home country? Yes ___ No ___ Maybe ___

41. Rate the importance of each of the following items as they would affect your decisions about where you work in terms of the following scale: 1 = very important; 2 = somewhat important; 3 = hardly important; 4 = not important.

a. Country __ b. Salary __ c. Quality of scientists __ d. Quality of research facilities __
e. Likes and dislikes of my wife and/or children __
f. Other (specify) ____________________

42. How many papers have you published in your field?

1-5 ___ 6-10 ___ 11 or more ___ none ___

43. How many books or monographs have you published in your field?

1-3 ____ 4-6 ____ 7 or more ____ none ____

44. What countries do you usually publish your works in?

____

45. In evaluating a scientific statement, journal article, etc. by a person in your field, do you ever take into account the fact that he is from a particular country/
Yes ___ No ___

If yes: In what way: ____________________

46. Please list the names of the scientific and scholarly societies you belong to and the countries they are located in.

Name of Country	Name of Society
____________________	____________________
____________________	____________________

47. How often do you attend the meetings of these societies?

Name of Society

____________________ every meeting __ most meetings __
some meetings __ no meetings __

____________________ every meeting __ most meetings __
some meetings __ no meetings __

48. Are you, or have you been a member of any non-professional organization (civic, charitable, religious, political, etc.) in your home country?
Yes ___ No ___

49. To what extent do you support the following statements? Use the following rating: 1 = Strongly agree; 2 = Agree; 3 = Neither agree nor disagree; 4 = Disagree; 5 = Strongly disagree.

a. My country should stay as it is, i.e., it should not change. ___
b. What my country needs most is greater economic development. ___
c. A greater effort in my home country must be placed on a rediscovery of its past. ___
d. The values of science should influence the values and ways of life of the people and leaders of my home country. ___
e. The problems confronting my country must be seen as international in nature. ___
f. My country should follow and develop its own course thru history and not copy other nations. ___
g. There should be more international cooperation between my country and other nations. ___

50. What affect have your experiences here and in other countries had on the way you view people, societies, and the world?

____

____

____

____