THE ROLES, WORK PATTERNS AND THIRD CULTURAL NETWORKS OF ACADEMIC SCIENTISTS IN MALAYSIA

Dissertation for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

ABU HASSAN OTHMAN

1977

3 1293 10038 2765

LIBRARY
Michigan State
University

This is to certify that the

thesis entitled

THE ROLES, WORK PATTERNS AND THIRD CULTURAL NETWORKS OF ACADEMIC SCIENTISTS IN MALAYSIA

presented by

Abu Hassan Othman

has been accepted towards fulfillment of the requirements for

Ph.D. degree in Sociology

John Useem
Major professor

Date August 12, 1977

O-7639

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.

DATE DUE	DATE DUE	DATE DUE
OCT 1 1 1992		
SEP 2 5 1998		

MSU Is An Affirmative Action/Equal Opportunity Institution
c:\circ\datedue.pm3

ABSTRACT

THE ROLES, WORK PATTERNS AND THIRD CULTURAL NETWORKS OF ACADEMIC SCIENTISTS IN MALAYSIA

By

Abu Hassan Othman

This is a sociological study of the roles, work patterns and third cultural networks of a sample of academic scientists in Malaysia. The scientists are part of two larger collectivities: the world scientific community and the Malaysian scientific community.

The manifold cross-cultural systems of the global scientific community consist of both personal networks among scientists of different countries and institutional linkages across national boundary lines. The systems are created and maintained by circulation of scientific publications, international meetings, exchange of students and scholars and by the personal communications, visits and collaborative research among scientists. It is sustained by governments, private foundations and international agencies.

The Malaysian scientific community has professionally based networks and grouping within the country which exhibit social and cultural patterns particularized to the social heritage, ethnic groups, the political economy and aspirations for the future. These deeply influence the style and norms of behavior among

scientists and affect the creation and dissemination of knowledge in the country.

Data were collected by questionnaires from a disproportionate, stratified, cluster sample of eighty academic scientists from four universities in greater Kuala Lumpur. The sample was stratified by: gender; six disciplinary areas--physical sciences, engineering, three life sciences (general, agricultural and medical) and social sciences; ethnicity--Malays, Chinese and Indians; generation; highest degree earned; country of highest education; and institutional affiliation. Ethnographic study was conducted on the work environs of the scientists.

The analysis is organized around three themes:

1. The patterns of research activities of scientists and the factors affecting their activities. The findings show that scientists' work and achievement are unequally distributed in the disciplinary fields. Those in life-general and life-medical are actively engaged in research. Most scientists in other disciplines are constrained by administrative and other involvements in doing research. Many scientists feel they have adequate funding and facilities for their research but some report insufficient funding and poor facilities. Nonetheless, many of their research accomplishments have been published abroad, suggesting they are not merely consumers of knowledge produced by foreign scientists but also moderate creators of knowledge which is shared globally.

2. The networks established by the scientists inside Malaysia for the purposes of creating, sharing and disseminating

knowledge. Scientists differentially communicate and establish personalized relationships in Malaysia with "significant colleagues" in their own institution and with selective professional colleagues outside their own university. These colleagues include both foreign and Malaysian scholars. The totality of the networkings of interpersonal relationships among these scientists within the country suggests the existence of a scientific community which Crane calls the "invisible college." Although there are isolates and differential degrees of involvement, there is considerable evidence of a community of scholars with shared interests.

3. The trans-societal networks of scientists and the patterning of their third culture. Every Malaysian scientist has personally encountered foreigners in their professional activities either in Malaysia or abroad or both. Consequently, interpersonal ties (extensive, intensive or slim) have developed between Malaysian scientists and their foreign colleagues located in Western centers of world science, and, on a more limited scale, in several other regions of the world. In addition, they attend international meetings and receive publications. Remaining cognizant of developments in science and technology beyond the horizon of Malaysia is important to them. However, this interest in an interdependent world is matched, for most, with a self-conscious concern for making their own scientific contributions to the future of their own country.

THE ROLES, WORK PATTERNS AND THIRD CULTURAL NETWORKS OF ACADEMIC SCIENTISTS IN MALAYSIA

By

Abu Hassan Othman

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Sociology

1977

8107019

© Copyright by
ABU HASSAN OTHMAN

1977

To my Mother

and

in memory of my Father

ACKNOWLEDGMENTS

In the course of my graduate education at Michigan State University and especially in the writing of this thesis, I have incurred debts to a great many people and institutions. However, the first thanks must go to Professor John Useem. As major professor, and chairman of my doctoral committee, he has been my primary intellectual mentor, friend and colleague throughout my graduate career and the source of many of the central ideas in this study. He has been concerned with my academic work and ever supportive in easing some of the extra-academic difficulties I was experiencing during the course of my education and study. Professor Ruth Hill Useem has always been an admirable scholar whom I am ever proud to work with. She, too, has played a central role in my doctoral research program. I am extremely grateful for her ideas, suggestions, encouragement and support. Both of them gave much of their time, energy and guidance at various stages of the preparation of this thesis to a degree far exceeding that ever expected of one's thesis advisors. I am especially indebted to both of them for making my intellectual growth as a sociologist stimulating and rewarding. The orientation and methodology of my study was heavily influenced by the Edward W. Hazen Foundation's project on the comparative study of the scientific communities in South and Southeast Asia which they directed.

Sincere thanks are also due to the other members of my doctoral guidance committee: Professors James B. McKee, William L. Ewens, and Richard Child Hill. All of them took the time to carefully read both my research proposal and thesis, and to provide helpful comments. I have benefited from their classes and the intellectual discussions I have had with them.

My special thanks go to Universiti Kebangsaan Malaysia (The National University of Malaysia) for granting me the study leave and financial support throughout my graduate studies in the United States and contributing significant assistance to me during my field research in Malaysia.

My thanks also go to the Institute of International Education of the United States (IIE), and the Malaysian American Commission for Educational Exchange (MACEE), Malaysia, for awarding me the Fulbright-Hays scholarship. This major financial support made possible my coming to Michigan State University for my graduate education and training. I am also indebted to Dr. August Gerald Benson, Foreign Student Advisor, Michigan State University, for his personal help in facilitating the renewal of my grant from IIE during my residence at MSU. I would also like to indicate my thanks to the Committee for the Comparative Research Area, Department of Sociology, Michigan State University, for providing me an assistantship, which in part funded my fieldwork in Malaysia.

During the time I was in Malaysia, January 1976 to June 1976, to conduct the field study, I was fortunate to have a great many people who were more than kind in extending to me every assistance

possible. I especially want to record my thanks to the following eminent science-administrators who gave so generously of their time and who so reflectively answered my questions: Datuk Murad Mohd Noor, Director General of Education, Ministry of Education, Malaysia; Datuk Dr. Anuwar Mahmud, Vice-Chancellor, Universiti Kebangsaan Malaysia; Professor Ungku Aziz, Vice-Chancellor, University of Malaya; Professor Yip Yat Hong, Deputy Vice-Chancellor, University of Malaya; Encik Abdul Hamid Mohd Tahir, Deputy Vice-Chancellor, University of Technology; Encik Mohd Noor Haji Ismail, Deputy Vice-Chancellor, University of Agriculture; and Dr. E. K. Ng, Deputy Director, Rubber Research Institute of Malaysia.

I would also like to sincerely thank the chairman of departments and deans of faculties of the respective universities who helped open the way for me to meet and interview members of their departments and/or faculties selected in this study.

I would also like to convey my thanks to several librarians, especially Cik Hapipah Mubin of Universiti Kebangsaan Malaysia, Puan Rohani Rustam of the University of Agriculture and Mr. Edward Cheah of the University of Malaya who helped me with the materials needed for this study.

My colleagues in the Department of Anthropology and Sociology, Universiti Kebangsaan Malaysia, have in various ways helped me during the course of my field study. In particular I wish to thank Encik Mohd Dahlan Haji Aman, the Chairman of the Department, for his personal support during the period of my stay in Malaysia for the research. In addition, I thank Encik Mohd Radi bin Zun, an undergraduate of the University of Malaya, who was my research assistant during the course of my fieldwork.

I would like to take this opportunity to again convey my deep feelings of appreciation to the "sample" members of the Malaysian academic scientific community who have generously given their time and patiently answered my questions. Without their positive responses and cooperation, this empirical study could not have been accomplished.

A special expression of gratitude is due to my wife Jamilah who has been constantly a source of invaluable support during the whole period of my education. She typed all the drafts of this thesis but the final one. The life I share with her and our two children, Eliza and Afdzal, has made the process of learning and research more joyous and the constraints, pains, disappointment and difficulties tolerable. Their patience was admirable. For all this, they have my appreciation.

TABLE OF CONTENTS

Chapter		Page

LIST OF TABLES

Table Page

Table		Page

Table		Page

Table		Page

CHAPTER I

DESIGN OF THE STUDY

Statement of the Sociological Problem

At its inception, the sociology of science and the allied fields of inquiry were centrally concerned with the relations between the scientific community and scientific knowledge on the one hand and the wider society on the other. This was true, for instance, of Merton's early work on the emergence of modern science (Merton, 1973) and on the norms governing scientific research (Hagstrom, 1965; Merton, 1973). Science, whether considered as a social system (Storer, 1966) or an estate (Price, 1965), has been investigated largely in terms of its internal structure, norms and values. In recent years there has been a growing concentration upon the internal characteristics of the scientific community, with the wider social setting taken as given and relatively unproblematic (see Blume, 1974). Those responsible for these more narrowly focused studies have not been aware that the scientific community is subject to external influences. But they have assumed that at least in some modern societies it has sufficient autonomy to make a separate analysis of its internal processes acceptable as a first approximation.

This research strategy has proved to be fruitful. It has enabled researchers to isolate a series of manageable problems and has produced results which have significantly improved our understanding of social stratification in science (Cole, 1972), the reward system of science (Gaston, 1970: 718-32), social control in science (Storer, 1966), the development of research areas (Crane, 1972), the recruitment of new scientists (Turner, 1960; Hargens and Hagstrom, 1967), scientific advisory structures and processes (Dupree, 1957; Pelz and Andrews, 1966; Schooler, 1971), as well as difficulties faced by scientists in industry (Glaser, 1964; Kornhauser, 1962; Volmer and Mills, 1966) and so forth.

The impression derived from much of the literature is that it has been implicitly assumed that science is a homogeneous entity, a community of like-minded scholars adhering to similar norms and values. Another implicit, although unstated, assumption has been that the model or configuration of science, its norms and values, is what it is in the West, not what it is in other parts of the world. There has been little concern with comparative studies, other than various consideration of manpower problems (Harbison and Myers, 1964; Brown and Harbison, 1957); in the adjustment of the foreign-educated to their indigenous cultures (Useem and Useem, 1955; Hodgkin, 1972) and on the third culture of science (McCarthy, 1972; Restivo, 1971; Vanderpool, 1971; Useem, in progress). Consequently, writings focusing on science and the scientific community within the modernizing societies of the third world are scanty. But the few available studies contribute some insights to our understanding of the growth patterns and development of science in the newer societies. Nader (1968), Rebeiro (1967), Shah (1967), Shils (1961, 1966, 1972) and Sinha (1970), among others, together point to the different cultural, political and economic environments in which science is being developed within the third world. Basalla (1967) suggested that science was originally an importation by colonial masters (e.g., by the British in India and Malaysia, the Dutch in Indonesia, the Spanish in the Philippines) except perhaps for China (Kwok, 1965; Wang, 1966). Rather than being part of a social movement for modernity, science thus becomes the purview of an elite of both foreign colonialists and educated nationals, who often become increasingly isolated from the masses.

Such isolation prevents the penetration of science into the total society, or its establishment in the country. Matejko (1967: 367-76) and de Solla Price (1963: 102-6) have discussed the problems confronting researchers in the third world: conflict between teaching and research, little time for research, unimaginative administrators and traditionalism in universities, inadequate research facilities, scant financial support, lack of established sources of support and recognition for scientific achievement as well as continued reliance on the knowledge and advances in technology in the West. These factors led de Solla Price to a conclusion that science in the third world will remain "dependent science."

In the sociology of science much has been written about the structure and process of science in the Western world. But, from a comparative perspective, there are a number of basic issues that are little explored. For example: What is the culture of science in the third world? What is the significance of the colonial

heritage with respect to science and technology? How do the government and the newer scientific community differ? How do government policies regarding modernization and development affect the growth patterns of the scientific community in those countries? What are the work-associated roles of scientists and their constraints in relation to the modernization and the development of the total society? How do scientists participate in the generating of a new culture in their societies? What is the nature of the relationships of the local scientific community to the epicenters of global science? Within the world-encompassing scientific collectivity, what are the different networks among scientists?

The present study, then, is aimed at looking into the scientific activities of scientists and their cultural networks in modernizing society in Malaysia.

The Third Culture of Science

The interest in comparative study of science and the scientific community has emerged and crystallized particularly in the last ten years. This is partly in response to the parochialism of Western sociology and the realities of an increasingly complex interdependent world. An important reason for emphasizing this perspective is the significance of science--logically, technologically and ideologically--for industrialization, modernization, and social change in general at societal and global levels (Restivo and Vanderpool, 1974: 3). Contemporary scientific networks are linked to each other by more or less well-developed systems of transportation,

communications, and exchange that cut across geographical, political and cultural boundaries: these networks are part of a supra-societal system variously referred to as the international scientific community, the third culture of science, the scientific superculture, and the scientific lateralization (Restivo, 1971: 187-205).

Scientific activities at this level are primary links between and among societies. These links are created and shaped by increasing interdependence between world-wide societies for resources, technology, markets, audiences, capital, information and social knowledge, and the continuing coalescence of domestic and foreign affairs. Our primary organizing sociological conceptualization in this study is "the third culture of science."

Following the Useems, the working definition of "the third culture of science" is "the cultural (including intrascientific) patterns inherited and created, learned and shared by the members of two or more different societies who are personally involved in relating their societies, or segments thereof to each other" (Useem, 1971: 14). Such a construct is an attempt to conceptualize patterns created by the increasing relationships among and between persons across cultures who, by virtue of shared interests which bring them together, generate new human groupings (Useem and Useem, 1963: 481-98). These groupings arise out of the interaction of people who share some common interests, and who in the process of interacting increase the scale of scientific activity and consciousness, create and establish new values, outlooks, life styles, and behavior patterns which are generic to none of the parent cultures involved.

Basic to this idea are the following assumptions (Useem, 1971: 14-16):

1. Men-in-the-middle of intersecting societies function as cultural brokers between intersecting social units, societies, and countries. As men-in-the-middle, they are a cultural exchange unit in the continuing interactions between the larger societies and countries.

2. The carriers of "third cultures" are a very limited segment of the total population: mostly individuals who have received a modern and higher education, have an occupation or a profession that is part of the modernizing-developing nation-building institutions, and typically have been recruited as adults.

3. These cultural brokers view themselves and are viewed by their consociates as actively engaged in future-oriented activities in which what is achieved in the present will prove valuable to subsequent generations.

In addition, third cultures are not closed, but open-ended cultures which

> depend for their existence and meaning on the larger collectivities of societies, countries and the international world. Consequently, they are subject to constant changes, intermittent conflicts, and numerous specific accommodations, as the larger human groupings on which they depend change. The world-wide political and economic forces, the shifting alignments of power among and within nations, the ideas and ideologies which originate in some parts of the world and then quickly spread round the globe, all these impinge on any one third culture. Thus, while a third culture is in one respect a creator of new patterns, it is also in another respect a creature of the world conditions which prevail (Useem, 1971: 16).

Within the context of an increasingly interdependent world, the Useems focused on modernizing roles in the third culture:

> Part of the enlarged scale of interdependency between the newly-developing and the more developed countries, a predominant characteristic of our time, are the systems designed to facilitate the process of modernization: progress 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 organization (Useem and Useem, 1968: 143).

The Useems anticipate a growing concern in the third world with creating national scientific communities, on a larger scale. The conception of the third culture has led them to study the "expansion of the scientific community and their cultural networks" as systems designed to facilitate the process of modernization in society. To explore further a specific instance of the third culture of science, this research is focused on the scientific community and its culture in Malaysia, and its relationship to the scientific collectivities of the wider world.

Viewed from a global perspective, the scientific community in Malaysia is part of two larger collectivities. First, it is part of the world scientific community which gives primacy to the idea that science-based knowledge has no national boundary lines. The world scientific community and its manifold ecumenical systems are made up of the personal and institutional networks of scientists of various disciplines and specializations. Communication is maintained by circulation of books, professional journals, magazines, and reprints; by attendance at national, regional, and international conferences, through correspondence and visits among scholars and colleagues; by securing placement for students; and by post-graduate study. It is also sustained by foundations and government-supported exchanges of scholars, cooperative university research and training programs, international and regional centers for coordinated studies of special topics.

Recognition, respect and prestige from this global collectivity, though it carries no sanctions, are expressed in invitations to deliver lectures or to present papers at meetings, by acceptance of articles for publication in journals, by citation in the literature and requests for reprints, and by the granting of research and travel support. Second, within the country, the scientific community forms societal-based networks and groupings. Their collective activity is imbued with particularized cultural and social patterns. This is because ethnic groups and the nation deeply influence the style and norms of behavior among scientists and significantly affect the creation, storage, and dissemination of scientific knowledge in the various parts of the country.

Malaysian scientists are just starting to advance and to be accepted as one of the important groups close to the centers of power, who can perform vital functions in developing, modernizing and building a national culture.

In summary, the theoretical orientation of the study has two primary bases: the sociology of science and the sociological construct, third culture. From the literature on the sociology of science, some concepts, especially of the social organization of science as an institution with its attendant hypothesized behavior, norms and values, will be used wherever applicable in the analysis of the Malaysian data. The literature dealing with the third culture of science provides a framework for analysis of the work-associated roles and cultural networks of Malaysian scientists.

The Study Design

Scope and Content of Study

The study seeks to describe and analyze a particular segment of science in Malaysian society, the academic scientific community. They are performing modernizing roles in society. They train manpower, educating them for modern professional, technological and managerial roles in the total society. They conduct research on various problems. With some, their research may be neatly articulated with the requirements of particular occupational or professional fields. With others, the emphases may be on general scholarly and theoretical pursuits. In some, the search for knowledge for its own sake predominates. Nowadays, the increasing recognition granted to academic persons by decision-makers in government and business has had unanticipated consequences within the academy. Many are now consultants or technocrats to government, industry and foundations, as well as the civic groups of the larger society. Their advice is eagerly sought by powerful decision-makers.

The purpose of this study is threefold. Firstly, it is to investigate: the work-associated roles of scientists in the academic institutions in Malaysia, as researchers, technical consultants to government agencies, private industry, foreign country's foundations, international organizations, and civic groupings; interpersonal networks involving other Malaysian scientists, institutions, and also scientists in other countries around the world. Secondly, it is to consider how the professional activities of scientists contribute to the growth and patternings of science and the scientific community in the country, as well as to the modernization and development of the total society. Finally, in a broader context, taking the roles and activities of the academic scientists as a whole, the purpose is to examine the structure of the Malaysian scientific community and its relationship to the epicenters of the global scientific collectivity.

For this study, empirical data were gathered during five months of fieldwork (February-June, 1976) at Kuala Lumpur, Malaysia. An indepth study of eighty scientists from four universities in the country was made. Altogether, there were 359 items distinguished during the fieldwork. Not all of these items will be analyzed. Instead, a set of independent variables--gender, ethnicity, major area of science, highest degree earned, place of highest education, university affiliation, and generation, and selected dependent variables--research, consultative and advisory functions, networks with other scientists within the national boundaries, and trans-societal interpersonal networks, will be used in the analysis. The analysis in the following pages attempts to bring understanding to such domains as:

1. the collective identity of scientists: their distribution by university, major area of science, ethnicity, social class, educational level, and generation.

2. the socio-political structure and its third-cultural heritage in relationship to the emerging institutions of higher education and the scientific community.

3. the social organization of research activities of scientists: issues related to time spent in research, types of research, sources of funding for research, factors influencing choice of research problem, accessibility to facilities for research.

4. the sharing and dissemination of knowledge: communication between and among scientists within their institutions and the country; involvement and participation in national scientific conferences, seminars, and workshops; membership in professional and scientific organizations; the recipients and end users of knowledge; the scientists as consultants and technocrats.

5. patterns of linkages in third cultures of science, created and maintained by scientists with their science counterparts from other parts of the world.

This approach, it is hoped, will put in a clearer perspective a small portion of the total picture of science and a scientific community in relation to a modernizing society of Southeast Asia.

Selection of Institutional Focus: Universities

As a way of limiting the scope of the study, only the educational sector of the society has been considered as a source of the sample of scientists to be included. Academic institutions, particularly universities, are important in several ways. In fulfilling the needs of a modernizing society, universities in Malaysia have become large and influential educational and scientific institutions. Today universities carry the major responsibility for professional and scientific education. Contemporary Malaysian universities are multifunctional organizations. They provide undergraduate and limited graduate instruction and open the channel of mobility for a rising number of students. They are intellectual centers, with libraries and laboratories to advance the frontiers of knowledge, and they supply, through their teaching, the high level manpower needs of the society.

In highly industrialized countries, the setting of development goals and strategies is assisted by a series of institutions and milieux where long-term thinking and research can be undertaken, e.g., academies, research and development centers, private industries, associations of the intellectual groupings. But in a number of countries in the third world beginning their development, such as Malaysia, the university is the place where much of the creative intellectual and technological energies of the nation are concentrated. In addition, the great majority of the highly educated--those with post-graduate training and research experiences--are

located in the universities. A few are employed in government-managed research institutes and private industries. There is limited scope for and variety in scientific research and development in private industry. This is because most of it is "multinational." Major scientific research and development is done not in Malaysia but in the home countries of the multinational corporations. Under these circumstances the universities with their newly created research institutions become critical factors in directing and shaping the kind of career a scientist has in Malaysia.

Malaysia has a unique higher education tradition in Southeast Asia: the universities are totally publicly supported. There are no private or sectarian (church-related) universities like those found in the Philippines, Indonesia and other countries. At the time of independence in 1957, there was only one university in Malaysia. But since 1969, due to the "demographic explosion" in the country--the combination of social, economic and cultural changes--and by the establishing of new government policies, four new public universities have been created. Thus, at present there are five universities in the country. Four are located in the greater Kuala Lumpur area: University of Malaya (Universiti Malaya), the National University of Malaysia (Universiti Kebangsaan Malaysia), University of Agriculture (Universiti Pertanian), and University of Technology (Universiti Teknologi). The fifth university, University of Science (Universiti Sains), is located in Penang about four hundred miles to the north of Kuala Lumpur, the nation's capital.

For the purpose of the study, only the four universities located in the Kuala Lumpur area were selected as the institutional focus. The amount of the grant, and the time available for the research were, in fact, the two principal factors determining this choice. The four universities were further divided into two classes:

1. The primate university. This is the University of Malaya (founded in 1959), the nation's oldest and largest academic institution. It was modeled, with some adaptations, on the British provincial universities and incoprorates their value system (Thompson et al., 1977: 241). It holds a position of great prestige among the country's universities. It is better equipped both in library and research facilities. It has a longer tradition of scientific research and development than the other universities. It is also the academic home of most of the first generation of Malaysian scientists and scholars who entered the university since its inception.

2. The newer universities. These are the other three universities (The National University of Malaysia, University of Agriculture, and University of Technology). These academic institutions were not established by a colonial ruler but are a product of indigenous effort and aspiration. Being new, they have a collection of relatively younger-generation scholars who have recently returned from post-graduate training (mainly in the United Kingdom, United States and other Western countries) and have begun their careers within one of these universities.

The four universities together have been the major suppliers of high-level manpower to the country. Each is sensitive to subtle social and political pressures and counterpressures in Malaysian society, and each plays a unique role, not only in economic development, but also in the development of national consciousness and cultural integration.

Selecting the Sample of Malaysian Scientists

According to the figures reported by the government,[1] as of 1973, there were 61,848 scientists and technologists employed in Malaysia. Of the total, 13,768 were degree holders, and 48,080 were diploma holders. Of those with university degrees, 1,175 persons were employed as administrators and managerial executives, 2,239 were teachers at the universities and colleges, and 10,354 were employed as scientists and technologists in research institutions, manufacturing industry and other production agencies. Hence, according to these figures, less than one-fourth (16.3 percent) of the scientists were employed in the institutions of higher education in Malaysia in 1973.

In selecting the sample of academic scientists, a number of criteria were used. First, the sample was limited to Malaysians. The exclusion of foreigners was by no means to denigrate their important contributions to the growth and patternings of science in Malaysia; rather, it was a convenient way of limiting the range and

[1] Report on Manpower Survey in Malaysia, 1973.

variety of the sample population selected for this particular study. Second, the sample represents scientists of the four universities, of both genders, and of the three major ethnic groups (Malays, Chinese, Indians). Third, the sample was drawn from six different scientific clusters. They were the physical sciences, the engineering sciences, the general life sciences, the agricultural life sciences, the medical sciences and the social sciences.

In addition, the selection process emphasized productive scientists, i.e., those having authored or coauthored at least one publication. A "publication" is here defined as any article or the equivalent based on research, and what is circulated among colleagues in mimeographed form, as pre-prints, reprints, monographs, reports of proceedings of conferences, or in formal journals. A graduate thesis is not considered a publication, but a journal article or a book based on the thesis is so considered. A minimal criterion such as this serves to discriminate enough to insure that one is dealing with productive scientists rather than with purely teachers or administrators. Too, publishing is evidence of a researcher's active engagement in scientific work and the sharing of his research results with other professionals.

In picking the sample of productive scientists, an attempt was made to approximate the configuration of the Malaysian academic scientific community as found in the annual reports of the four selected universities. In 1975-76, there were about 862 scholars in the four universities. Of these, approximately 450 mentioned research activity of some kind, either reported in the annual reports of the different academic institutions, or by our personal interviews with selected heads of departments, and deans of faculties in the sample universities. The distribution of scientists by type of university and by major area of science is given in Table 1.

The physical sciences include the following disciplines: physics, chemistry, mathematics, geology and specific branches of geography, i.e., physical geography. Engineering includes civil, mechanical, electrical chemical, surveying, and town and country planning. General life sciences refer to biology, botany, genetics and zoology. Agricultural sciences refer to agronomy, soil science, horticulture, animal science, fishery, agricultural engineering, food technology, and forestry. Life-medical encompasses anaesthesiology, anatomy, obstetrics and gynecology, surgery, radiology, pharmacology, psychiatry and other related subjects. Not included in the sample is dentistry. The social sciences include economics, sociology, psychology, political science, anthropology, public administration, linguistics, geography and two branches of education --educational psychology and educational sociology.

In the primate university, it is evident that the majority of scientists are in the life-medical (33 percent), followed by the social sciences (30 percent), physical sciences (19 percent), engineering (10 percent), life-general (7 percent) and life-agriculture (1 percent). The low percentage of agricultural scientists located in the primate university is owing to a large number of them having joined the University of Agriculture when it was established in 1971. In the newer universities, the highest

TABLE 1.--Distribution of Scientists in Sample Universities by Major Area of Science.

Type of University	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agri.		Life-Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	862	100.0	119	13.8	246	28.5	57	6.6	85	9.9	160	18.6	195	22.6
<u>Primate University</u>														
Univ. of Malaya	462	100.0	86	18.6	46	10.0	32	6.9	7	1.5	151	32.7	140	30.3
<u>Newer Universities</u>														
Total	400	100.0	33	8.2	200	50.0	25	6.3	78	19.5	9	2.3	55	13.7
The National Univ.	76	100.0	12	15.8	0	0.0	12	15.8	0	0.0	9	11.8	43	56.6
Univ. of Agriculture	124	100.0	21	16.9	0	0.0	13	10.5	78	62.9	0	0.0	12	9.7
Univ. of Technology	200	100.0	0	0.0	200	100.0	0	0.0	0	0.0	0	0.0	0	0.0

percentage of scientists are in engineering (50 percent), followed by life-agriculture (20 percent), the social sciences (14 percent), life-general (6 percent) and life-medical (2 percent). The reason for this very different distribution is the newly established University of Agriculture and University of Technology: they are respectively engaged in establishing a curriculum in agriculture and engineering.

Following the general outlines of the Malaysian academic scientific community doing research, 80 scientists having at least one publication were randomly selected from among approximately 450 scientists in the four universities. Our sample of 80 scientists, then, is approximately an 18 percent sample of this number. This sample of 80 scientists were subcategorized in order that they represent: male and female scholars; six scientific disciplines--physical, engineering, life sciences (general, agricultural, medical) and social science; three ethnic groups--Malay, Chinese and Indian; the generation of senior and younger scientists. In addition, of the total sample scientists, 51 (64 percent) were selected from the primate university, and 29 (36 percent) were from the newer universities. The sample was formed this way for the following reasons: (1) Not only many scientists in the primate university were eminent, but also they had been engaged in research much longer than their counterparts from the newer universities. (2) Some scientists in the primate university were highly visible and productive. They have high reputations in the scientific community and the public-at-large as well. (3) Most of the generation of senior scientists are located in the primate university. Therefore, no study of science and the scientific community in Malaysia could afford to exclude them from the sample.

The Malaysian Study Design: The Ideal and the Actual

The initial plan of studying the scientific community in Malaysia was to encompass a sample of scientists working in the scientific organizations in the country, e.g., academic institutions, research institutes and public service organizations. This approach would have covered a wider range of scientific activity in the country. But to embark on such a project would have required substantial resources, such as funding, qualified research assistants, and time. For this reason and for lack of essential information about the actual distribution of scientists by organizations, gender, scientific disciplines, ethnicity and highest degree attained, the original plan was discarded. The only information available, apparently, on scientific manpower by occupations in the country was the report of the manpower survey initiated by the government in 1973. This information was too general to enable one to construct a meaningful sampling frame.

Instead, a study design was developed that centered primarily on academic scientists, a segment of the modernizing Malaysia, yet embodying in their experiences and behavior the larger issues of modernization and development. The main focus of the proposed study design was on academic scientists, from four universities in the country.

The study was originally to focus on the complex configurations of scientists' occupations and work style. The variables to be investigated were: the social origins of scientists (gender, social and ethnic identity, class background, education and training); the work-associated roles of scientists (teaching, research, consultative and advisory, and civic or political roles); the system of reward and recognition for scientific achievement; generation; the networks of scientists within the country and abroad; and scientists' perception of the role of science and technology in modernization and development. The study design was then modified as a consequence of the field situation. Variables related to teaching and to the system of reward and recognition for scientific achievement were dropped to reduce the scope of coverage. The content of the actual study is discussed in the following pages.

Description of Sample

Major Area of Science

Table 2 gives the breakdown by institutional affiliation and major area of science of the scientists interviewed. Of the total 80 respondents interviewed, 12 were physical scientists (15 percent), 13 engineers (16 percent), 14 life-general (18 percent), 13 life-agriculture (16 percent), 13 life-medical (16 percent) and 15 social scientists (19 percent).

Social and Ethnic Identity

The distribution of the sample scientists (a) by ethnic identity, classified in major ethnic groups--Malay, Chinese and

TABLE 2.--Distribution of Sample by University Affiliation and by Major Area of Science.

University Affiliation	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agri.		Life Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	12	15.0	13	16.2	14	17.5	13	16.2	13	16.2	15	18.8
Primate University														
Univ. of Malaya	51	100.0	9	17.6	8	15.7	9	17.6	0	0.0	13	25.5	12	23.5
Newer Universities														
Total	29	100.0	3	10.3	5	17.2	5	17.2	13	44.8	0	0.0	3	10.3
The National Univ.	7	100.0	3	42.8	0	0.0	3	42.8	0	0.0	0	0.0	1	14.3
Univ. of Agriculture	17	100.0	0	0.0	0	0.0	2	11.8	13	76.4	0	0.0	2	11.8
Univ. of Technology	5	100.0	0	0.0	5	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Indian--and (b) by gender, (c) by age, and (d) by marital status will be analyzed below:

TABLE 3.--Distribution of Sample Scientists by Gender and by Ethnic Identity.

Gender	Ethnic Identity							
	Total		Malay		Chinese		Indian	
	N	%	N	%	N	%	N	%
Total	80	100.0	27	33.8	36	45.0	17	21.2
Male	65	100.0	24	36.9	27	41.5	14	21.5
Female	15	100.0	3	20.0	9	60.0	3	20.0

The ethnic distribution of the sample suggests one important phenomenon, viz., the relative preponderance of the Chinese among scientists amounting to 45 percent in the sample. As a matter of fact, in contrast to Malay and Indian, the number of Chinese in scientific and professional occupations in Malaysia is fairly large. To cite a few examples, according to the government's national manpower survey in 1973 in Malaysia, it was found that the ethnic breakdown of those employed in professional occupations in the public sector was significantly different from that in the private sector. In the public sector, the composition of those employed in professional occupations is consistent with the racial composition of the population. As of 1973, 53 percent were Malays, 36 percent Chinese, 10 percent Indians and 1 percent others. In the private sector, however, only 17 percent were Malays, 69 percent Chinese, 12 percent

Indians and 2 percent others. In terms of specific professional occupations, Malay participation is low in the physical, engineering and medically related sciences. In 1973, Malays accounted for only 12 percent and 14 percent of those employed as physical and engineering scientists, respectively, while the Chinese formed 77 percent and 69 percent of the total. Indians formed 11 percent and 17 percent of persons employed as physical and engineering scientists, respectively. Among doctors, only 7 percent were Malays, while 50 percent were Chinese, 37 percent Indians and 6 percent others.

Part of the explanation for the relatively high concentration of Chinese in science lies in the excellent facilities and opportunities for elementary and secondary educations in some of the predominantly Chinese communities--particularly in the cities. By and large the Chinese have had instruction in mathematics and sciences far superior to that in the rural areas where Malays predominate.

The Malays, who constitute 34 percent of the sample, are primarily new arrivals (nonveaux arrives) to the world of science. The interest in science and technological education was not vigorously mobilized until the 1960s and continued into the 1970s. Their late entry is the result of the lack of opportunities, incentives, and adequate facilities (good schools, libraries, laboratories) for science education during the colonial era, particularly for the Malays. In addition, prestige and status granted to the Malaysian Civil Service, better known as "MCS," has motivated a large number of intelligent Malays to pursue their education not in the sciences but in fields that would provide them entry into the civil service: the social sciences, humanities and law.

The Indians, too, though a minority group, and constituting 9 percent of the total population of the country, have attached great value to education, particularly to economically and socially prestigious forms of education such as science and medicine. The Indians constitute 21 percent of the sample. This ratio is fairly representative of their proportions in the national scientific community as well.

There are 65 male scientists (81 percent) and 15 female scientists (19 percent) in the total sample. The fact that only 19 percent of the sample is female reflects the still very few qualified women both in the academic institutions and the country.

Table 4 indicates that the scientists are relatively young. Of the total sample, 75 percent (60 cases) were under and 25 percent (20 cases) were over 40 years of age.

TABLE 4.--Distribution of Scientists by Age.

Age	Number	%
30 years and under	8	10.0
31-35 years	25	31.2
36-40 years	27	33.8
41-45 years	15	18.8
46 and over	5	6.2
Total	80	100.0

One would infer from this that a substantial number of the sample received their undergraduate training in the late '50s and early '60s, which suggests that the development of the indigenous scientific community is mainly a phenomenon of the post-independent era. As regards marital status, over 90 percent (74 cases) are married, and of this number only about 14 percent (10 cases) are childless. The great majority have small families, if one arbitrarily interprets a family with three children or fewer as a small family. A total of 77 percent (57) cases of the sample interviewed have three children or fewer in their family.

Class Background

Class may be defined sociologically as how people stand in the socioeconomic hierarchy with respect to occupation, income, education, and other variables having to do with resources they possess. But in the absence of any scale for the evaluation of social stratification in Malaysia, we have tentatively employed father's occupation as a single index, however inadequate that may be, of social class.[2]

Table 5 gives the suggested classification of occupations according to probable social class, and the distribution of the sample within these categories.

---

[2] It must be emphasized, however, that what is presented here is quite an arbitrary and a priori classification whose validity has to be established on other grounds such as empirical ranking of occupations according to prestige, a task which has yet to be done in social ranking in Malaysia.

TABLE 5.--Social Class Background of Scientists.

Class	Number	%
Total	80	100.0
Upper Middle Class		
Professionals, top administrators, bankers, managers, landed proprietors	21	26.2
Middle Class		
Scientists, businessmen, middle-level administrators, graduate teachers, specialized technical officers	16	20.0
Lower Middle Class		
Clerks, small businessmen, teachers, other white-collar workers	29	36.2
Working Class (Including Peasants)		
Hospital attendants, skilled and unskilled laborers, rubber tappers, and farmers	14	17.5

A significant characteristic of the above data is that more than half of the sample (53.7 percent) have their origin in the lower-middle and working classes, i.e., their fathers have typically been clerks, ordinary school teachers, small businessmen, rubber-tappers and laborers. Since the scientists now belong to the middle class, all those from the lower-middle and working classes have experienced a substantial change in their social-economic status in life. The emerging trend in the post-independence era is for the lower-middle and working class families to recognize the socioeconomic value of education for upward mobility and therefore to make great sacrifices to give their children the best available education. The consequences of such an orientation to education and social mobility are evident in the occupational achievements of their children, as displayed in this sample. As regards the upper-middle and middle classes, it is often suggested that they are more likely to have a home environment in which the children have better opportunities to acquire the intellectual skills they need to do well in school. Their children may attend better schools, which induce them to go to college, as the present sample of scientists indicates.

Education and Training

Approximately 68 percent (54 cases) of the sample have received the greater part of their secondary education in the "elite" schools located in the metropolitan areas or towns. These public schools, originally established on the model of the English public schools as the training ground for the local gentry and bureaucracy, are maintained by the government. The other 32 percent (26 cases) were educated in ordinary secondary schools.

As regards university and college education, particularly at undergraduate levels, 51 percent (41 cases) had their training inside Malaysia and Singapore, while 49 percent (39 cases) had their training abroad (mainly in Australia, New Zealand and the United Kingdom). Post-graduate training for Malaysians is predominantly foreign.

TABLE 6.--Characteristics of the Malaysian Scientific Community Sample of Published Academic Scientists by Highest Degree Earned, by Place Granting Highest Degree and by No Foreign Education.

Highest Degree Earned, Place Granting Highest Degree, and No Foreign Education	Number	%
Total in sample	80	100.0
Highest Degree Earned		
Bachelor	1	1.2
M.B.B.S.	12	15.0
Masters (1 had a degree in Pharmacology)	20	25.0
Doctorate	47	58.8
Place Granting Highest Degree		
Malaysia	10	12.5
Philippines	1	1.2
India	1	1.2
Australia/New Zealand	14	17.5
Canada	6	7.5
United States	9	11.3
Great Britain	39	48.8
No Foreign Education	5	6.3

Table 6 reveals that more than three out of four scientists in the sample (87.5 percent) received their post-graduate training abroad, mainly in the United Kingdom, Australia and New Zealand, United States and Canada. One had his advanced education in the Philippines and another in India. Only 12.5 percent spent their entire post-graduate years in Malaysian institution. This suggests, then, that higher education, particularly at the tertiary level, is still highly dependent on foreign countries. Most significantly,

the preferences and opportunities are primarily at the universities in the United Kingdom, Australia and New Zealand. Almost two out of three persons in the sample (66.2 percent) had their advanced education in these countries. The reasons for this are the extensive links between the established local scientists and their counterparts in the United Kingdom, Australia and New Zealand, as well as the similarities and affinities in the educational systems of Malaysia and these countries.

Less than one-fourth of the sample (18.8 percent) came to the United States and Canada, although the trend is rapidly increasing nowadays. This disparity and change reflects the earlier and now shifting nature of the relationship between Malaysia and other societies.

Among the academic scentists interviewed, one had a bachelors degree. He is an agricultural scientist. Twelve had medical degrees, M.B.B.S. The majority of these had their first degree training in Malaysia and Singapore, but later when to the United Kingdom for advanced training in their specialized field. Twenty had masters degrees. They are three physical scientists, four engineers, one general life scientist, six agricultural life scientists, one medical life scientist, and five social scientists. Forty-seven had doctorate degrees. They are nine physical scientists, nine engineers, thirteen general life scientists, six agricultural scientists, and ten social scientists. For those having the masters and doctorate degrees, a majority of them had their advanced professional training abroad.

Generation

Knowing the combination of different generations of scientists in a modernizing society is important, particularly in relation to such questions as the experiences, outlook, and status of those who provide scientific leadership and the working scholars in the scientific community. It concerns which particular generation is active in research, in building networks within the country and abroad, in providing technical consultation to the government and other agencies. The arbitrary index used to class the scientists in different generations is the year in which they obtained their bachelors degree (including the M.B.B.S. degree). This is because the bachelors degree is considered the initial point of entry for a scientist into science and the scientific community. Using this index, the Malaysian sample academic scientists can be classified into four generations: (1) The first generation. One out of ten persons (10.0 percent) in the sample is in this category. They received their undergraduate training before Malaysia became independent in 1957. They were initially socialized in the colonial system, and then confronted the process of rebuilding their institutions. They are now the Malaysian senior scholars. (2) The second generation. Less than one-fourth (17.5 percent) of scientists belong to this group. They secured their first degree education between 1957-1961. This was the period following independence in which the development of "indigenous" science began to be initiated earnestly by the new leadership of the country. (3) The third generation. Scientists in this group had their initial degree training between 1962-1968. One out of two persons (58.8 percent) in our sample is in this generation. This period was marked by an intensive mobilization of persons for scientific and professional training at home and abroad. It is largely for this reason that we have a high percentage of scientists representing this category in the sample. (4) The fourth generation. Scientists in this generation received their bachelors degree between 1969-1975. By and large they have just returned to the country to begin their scientific activities.

Briefly reviewed, then, the sample of scientists selected for this study were of different genders, ethnic groups, scientific disciplines and generations. They were predominantly foreign educated and are at present involved in performing modernizing functions in the country. The scientists come in various proportions from the upper-middle and lower class families.

Research Techniques

This empirical study involved direct observation, respondent interviewing, informant interviewing and document analysis. The initial phase of fieldwork was the period of general observation, and preparation for and entry into the field. The design of this study was done in East Lansing, Michigan.

Entry and Establishing Identity in the Field

As a "native" Malaysian sociologist about to look into a segment of Malaysian society, one did not have to acquaint oneself with the particular geographic area. We were acquainted with the general sociological and ecological characteristics of the area, having worked and been educated at the university, and having established social relations there for approximately ten years. We began fieldwork by visiting the respective universities, and meeting with university officials both academic and administrative, to explain the focus of the study and its purpose, as well as to ask for their cooperation. We checked university records, particularly those related to scientists, scientific records and libraries, Malaysian scientific journals and newspapers. We found that these records were generally adequate in providing information pertinent to our study. We had informal conversations with the larger segments of scientists, government officials and leading citizens concerned with science. In time, we began to interact socially by attending forums, visiting the senior common rooms of the respective universities to meet with some scientists, visiting some houses of scholars, always keeping in mind that social interactions produce data. At this stage, we were generally able to identify those scientists who would be potential respondents, and those who, we thought, would share their knowledge.

Method of Data Collection

Pre-testing schedule of questions.--The self-administered questionnaire and interview schedule used in this study were first designed while we were still at Michigan State University, before we returned to Malaysia for the field study. It took almost three months to work out this schedule using the Philippine (Useem, Useem, and McCarthy, forthcoming) study as the point of departure. The questionnaire was pre-tested with two Southeast Asian graduate students in the sciences at M.S.U. Upon arrival in Malaysia, the interview schedule and the self-administered questionnaire were once more pre-tested under actual field conditions, with ten scientists selected from the National University of Malaysia and the University of Malaya. We conducted the pre-testing personally, in order to decide whether the schedule was workable. Although the main areas were firm, some minor adjustments were made because of confusing wording, inconvenient spacing and awkward format. Thus the questionnaire was polished to the point we thought best suited for the actual field situations and study.

The schedules and interview situation.--As indicated earlier the final sample of 80 scientists were randomly selected from 450 published academic scholars from four different universities. The sample were asked to participate in this study in two ways. One, they were asked to fill in the self-administered questionnaire described below. And, two, some selected respondents were asked to participate in an in-depth interview lasting one to two hours per person.

Distribution and collection of self-administered questionnaire.--The self-administered questionnaire was a 27-page printed set of questions covering six main topics. They were: (a) general introduction, (b) research, (c) consultation and advising,

(d) the networks of scientists within the institution and country, (e) the networks of scientists abroad, and (f) bio-data.

The questionnaire was in English, which is the principal working language of the scientists. In all, there were 85 questions (see Appendix). There were questions with checklists, fill-ins, and other structured items. The self-administered questionnaire was not mimeographed but printed, which decreased its bulk and, more importantly, increased its readability. Many of the categories and much of its terminology were simplified in order that it could easily be understood by the respondents who were not social scientists. The questionnaire was personally handed to each of the 80 scientists selected for this study, and each questionnaire was accompanied by a personal letter to the respondent, individually typed, explaining briefly the scope and purposes of the study.

In addition, a letter of introduction from our research advisor was also given to the respondent to further motivate participation in the study. We also explained the study orally. An appointment was made for us to come back and collect the completed self-administered questionnaire, usually one or two weeks later. Of the original 80 respondents selected, only six failed to complete the questionnaire for various reasons; two left to attend conferences abroad, one went on a long vacation outstation, and three claimed they were inordinately busy. They were replaced by six alternative respondents in order for the sample to remain at 80. Nonetheless, since our relationship with the respondents was genuinely cordial, the overall rate of return of the questionnaire was considered good.

Depth interviews.--Of the total sample, 14 scientists from six major scientific disciplines were selected for an in-depth interview; two in physical sciences, three in engineering, two in life-general, two in life-agricultural, three in life-medical and three in social sciences. An interview guide was used to maximize the probabilities of obtaining in-depth and consistent information on questions about research, consulting and advisory work, and networks and linkages of scientists. Since they were busy persons, the interview was held at the convenience of scientists. In all instances, the interview was held during the day, and in the office of the scientists, and lasted on the average about two hours.

Interviews with key informants.--Key informants were chosen because they possessed special qualifications such as knowledge, a particular status, official position, wide communications and accessibility to the investigator. In this study six key informants were selected. They were prominent scientist-adminstrators, representing universities, government and research institutes. Structured interviews were held, lasting about two hours with each person. They were asked the same series of questions about the general status of science and the scientific community in Malaysia; science policy planning; the critical problems in Malaysian society today, e.g., the relationship of agriculture and industry; the role of scientists and professionals in relation to politicians; the role of policy-makers in solving agricultural-industrial and socio-cultural problems; the nature of interfaces and the exchange of scientific knowledge between universities, government and private industry; and other issues related to the culture of science in a modernizing society. The interview guide was designed to get substantive ethnographic information, and in this case key informants were considered most reliable for providing an overview. There were no refusal or rapport problems with the key informants during the interviews. All of them were enthusiastic, candid and supportive of this study.

Ethnography.--A substantial portion of the data collected in this study were ethnographic in nature. Considerable work was done to connect general patterns to the scientific community: (1) on the history, socio-cultural heritage, and current socio-political situation in Malaysia; (2) on the educational system; (3) on each individual university. To get acquainted with these, we collected government documents, technical reports, conference papers, Malaysian scientific journals, in addition to interviewing knowledgeable people. The exploration of the universities included: (a) formal visits for individual meetings with senior administrators, i.e., the Vice-Chancellors and their deputies, deans of faculties, and department chairmen; (b) discussions and conferences with other university officials such as librarians and middle-level administrators; (c) the obtaining of detailed reports, and annual reports regarding the university; (d) an attempt at a general assessment of the relationship of university to the surrounding community and larger society.

In general, the ethnographic effort focused on such matters as the institutional environment in which scientists were located; the relationship of the institution to the surrounding community; the institutional linkages within the country; the institutional atmosphere regarding teaching and research; and policies regarding technical consultations and traditions on the civic roles of the scientists in the larger society.

Fieldwork Situation: Recapitulation and Assessment

In regard to the interview schedule, as indicated before, sample scientists were asked to participate in two ways, viz., by filling in the self-administered questionnaire and, selectively, by participating in an in-depth interview. By using the questionnaire and interview guide we were better able to avoid misleading and irrelevant questions, a fault commonly appearing in unstructured interviewing. In many cases, the interview involved only one or two visits with the respondents and, therefore, it called for more "formal" interaction. It also entailed less risk of "over-identifying" with the persons which could unconsciously influence the reliability of the information sought. The main limitation of the technique, however, was that it limited effective use of the personalized relationship that we established with the scientists for eliciting data. The questionnaire and interview guide were too structured to allow one to gather elaborate qualitative data and the subtle and complex peculiarities of the social phenomena studied.

As for the interviewer-interviewee relationship, the persons interviewed were easy to talk to, friendly and interested in the study. One of the reasons, perhaps, is that the study was the first of its kind done by a sociologist on science and the scientific activities of scientists in Malaysia. None expressed disapproval of the research. Field relations and rapport with key informants were uniformly good.

This study was done during a period in which Malaysia is in a critical stage of its growth, socially, economically, scientifically and intellectually. The national leadership, intellectuals, scientists and professionals, altogether, are concerned about nation building, in the diffusion of social knowledge and national culture to the countryside, and in the practical politics of accommodating to the demands of local interest groups for their fair share of the new opportunities related to the political economy. Sectors of the country which had been on the fringes in the colonial period want to be included in the national and global systems, lest they be left behind and their future generations be disadvantaged. The current occupation is toward building institutions and organizations of widely divergent quality, emphases and accomplishment. Attempts are being made to transmit social knowledge and the tradition of science, and to foster the appreciation of and demand for research work and research results by agriculture, industry and by other major institutional subsystems in the country. Perhaps a more critical development is the initial effort to foster the use of Bahasa Malaysia (the national language of the country) as the instrument of instruction and national unification in the national society, including the universities.

The extent to which these newer development efforts encourage or hamper research activities, strengthen or weaken links with the wider world community of scientists, curtail or broaden the program of modernizing the country's economy and culture, has raised interesting empirical questions for scholars. It must, therefore, be recognized that the present study was conducted during a period in which the culture of science and research activities are becoming more visible and rapidly growing in the country. Scientists have ample opportunities to enter a growing field of research during this critical stage of the country's development and none are unemployed. The cultures, experiences, behaviors and networks of scientists examined in the present study must be understood in the context of the particular socio-cultural, political environment and historic situation.

Limitations of the Study and Potentiality for Future Research

The concern in this study has been to examine only the case of the academic-based scientists. In a strict sense, the specific findings can be applied only to the population of 80 scientists actually studied. Nonetheless, to the extent the sample of respondents are representative of Malaysian academic scientists in general, the findings are at least suggestive of general patterns in the social structure of Malaysian academic scientific community. An expanded sample, perhaps, would provide an opportunity for further refinement and elucidation of the findings. Whether or not scientists in nonacademic institutions, e.g., research institutes, public service organizations, and private industry exhibit similar patterns and are engaged in more or less similar scientific activities raises new questions for research. If the analysis on science and the scientific community in Malaysia is to be taken further, we need to have numerous detailed studies of the parts played by scientists (including nonacademic scientists) in modernization and development and other aspects of social and cultural change.

The research perspective, the selection of institutional focus, the sample of scientists, the social and educational background of scientists, the research instruments, and field work experiences having been discussed, the setting in which the scientists selected for this study live and work will be analyzed in the following chapter.

CHAPTER II

THE SETTING OF THE STUDY

Malaysia: Its Socio-Political Structure and Third Cultural Heritage

Geographically, Malaysia covers an area of about 130,000 square miles occupying the Peninsular Malaysia and including the states of Sabah and Sarawak in northwestern Borneo Island. The two regions are separated by about 400 miles of the South China Sea. Peninsular Malaysia, covering an area of 52,000 square miles, has its frontiers with Thailand while Sabah and Sarawak, occupying about 78,000 square miles, border the territory of Indonesia's Kalimantan.

Malaysia is a country segmentalized by race, culture and language but united by economic and political necessity. Its society is characterized by such terms as "plural," "communal" or "segmental" (Furnival, 1948; Despres, 1967; Lijphart, 1968; Rabuska and Shepsle, 1972) because it is composed of a number of ethnic groups, each of which lives in distinct communities with distinctive cultural and social life style. Certain sectors of the economic or political system tend to be dominated by a particular ethnic group. Although each ethnic group has its own social, political and economic institutions, no communal group exists as an autonomous self-sustaining social unit. Instead, each community is dependent on other communities for some goods and services.

The three major ethnic communal groupings of Malaysia are the Malays, the Chinese and the Indians. In addition, there are a number of smaller communities such as the Dayaks, Kadazans, "other natives," Eurasians and Europeans (see Table 7).

TABLE 7.--Population Composition, Malaysia, 1970.[3]

Ethnic Group	Male	Female	Total	%
Total	5,270,571	5,168,959	10,439,530	100.0
Malays	2,433,800	2,453,112	4,886,912	46.8
Chinese	1,800,984	1,754,895	3,555,879	34.1
Indians	501,164	441,780	942,944	9.0
Dayaks	192,338	193,922	386,260	3.7
Kadazans	92,209	92,303	184,512	1.8
Other natives	169,056	168,339	337,395	3.2
Others	81,020	64,608	145,628	1.4

The socio-historical development and modernization of the country falls into three distinct phases. There was the pre-colonial phase in which traditional indigenous Malay cultural systems dominated the life of the people, although there were some elements of the Hindu and Islamic cultures, thought and philosophy.

The second phase (1874-1956) was the period of British colonialism during which time bilateral bonds of cross-cultural

[3]The source is from 1970 Population and Housing Census of Malaysia, Community Groups (Kuala Lumpur: Jabatan Perangkaan Malaysia,1972), pp. 24 and passim.

relationships characterized by the norms of superordination-subordination were established between the mother country, Great Britain, and Malaysia. Malaysia became a dependent colonial society in which the society and culture of the mother country typically served as the model for Malaysian society and culture.

The third phase began with constitutional independence attained in 1957. Under a new constitution, Malaysia became an independent nation in which the population underwent changes in their social status from "natives" to "nationals," and they collectively were mobilized and became participants in the building of new national cultures. The emerging emphases thereafter is on continued growth of the country into a modern society.

In order to understand Malaysian academic scientists and the scientific community, it is necessary to relate to these complex and variegated cultural systems, social structures and patternings occurring in each phase of the societal growth and development. Indeed, it is these complexly related cultural patternings and structures that in one way or another influence the work-roles, identity and performance of the scientists.

Pre-Colonial Era: The Indigenous Socio-Cultural System and the Hindu and Islamic Influence

The Indigenous Socio-Cultural System

The indigenous Malays, before the arrival of Hindu and Islamic cultures, had evolved a culture, a style of thinking of its own. Their culture and style of thought were closely bound up with the enormously important position of religion in the cultural life of the people. A belief in spirits and supernatural powers pervaded all aspects of the individual and communal life of the society. Thought and social action were centered around the question of how to get help from the good spirits and how to avert the influence of those that were mischievous or obstructive. There evolved in Malay society all kinds of rites, incantations, taboos and prescriptions regulating social life of the people. Economics, law, government, rituals and the arts of the society were not isolated human activities but were closely interwoven in the daily lives of community members so that, oftentimes, it was impossible to say where one began and another ended. Similarly, marriage, birth and death were not events which concerned merely individuals but rather the whole community was deeply involved, and such events were, therefore, inevitably closely regulated by social conventions.

The indigenous Malay community also featured a social structure typified by a two-class system: the traditional ruling class (Raja) and the peasantry (raayat). The ruling class lived in cities and consisted of the numerous members of the ruling families of the Malay states or of the families of the nonroyal district chiefs (Gullick, 1959). At the apex of the structure were the patrilineal kings (Sultans) drawn from royal patrilineages. Under the direction of the king and members of the royal household, the government was administered by members of the aristocracy. They shared power with a number of traditional social groups--the landed aristocracy, the district chiefs and the religious leaders. These ruling elites performed all the political functions, monopolized power which stemmed from the control of resources, both tangible and intangible sources of wealth, and enjoyed the advantages that power brings. By and large, they were conservative feudal landowners, and rather than seeking to increase wealth of the community through economic and social development, they were concerned with preserving the agrarian economy, the norms of fatalism and passivity as a guarantee of social stability and social stratification in Malay society.

The subordinate peasantry, on the other hand, lived, for the most part, in small village communities based on a semi-subsistence economy of rice and fruit growing (Swift, 1965; Wilson, 1967) or on fishing along the coast of Malaysia (Firth, 1966; Fraser, 1960). In the interior of North Borneo, Dayak farmers moved along the numerous rivers of the area (Freeman, 1955; Appel, 1965). They exercised little power in the traditional political system. They were passive in their public mood of thought, isolated in their environment, deeply influenced by traditional customs and subservient to the landed aristocracy and ruling elites in their civic action and social life.

Diffusion of Hindu and Islamic Thought and Culture

Indigenous Malay society and culture, traditionally based on small-scale village communities, did not remain isolated indefinitely. It began to change under the influence of Hindu and Islamic cultures. The intellectual, political and material activities that had occurred in India before the Christian era were perhaps the main stimuli that caused the migration of Hindus to the Malay Archipelago and other areas, venturing primarily into new economic and commercial activities. These new economic and commercial ventures and their related cultures increased; and cultural interaction between the Hindu traders and locals led to selective infusion of Hindu cultural elements into Malay cultural practices, particularly in religion, the economy, language and literature. For example, what indigenous Malays saw as spirits and supernatural powers with largely undefined forms and functions, the Hindus conceived as far more structured and far more distinct individually. Their gods were personified symbols of natural forces, were ranked in a definite hierarchy and with specific functions to perform in the cosmic process and in the life of man. The Malays came to this view, too.

Similarly, while the structure of indigenous thought and philosophy was still obscured by its integument of myth and traditional law (adat), the Hindus brought into Malay culture a new philosophy of man and his relations with society, new theories about the universe and the cosmic order, the Sanskrit language and literature, and ultimately generated a new ethical dimension to life in Malay society.

In short, the interaction with the Hindus resulted in the diffusion of many Hindu cultural traits into Malay society. Some of the more important effects were the rapid growth of new social units subsuming the smaller village communities and expanding the scale of social organization from the village to a large state or kingdom, one example being the establishing of the kingdom of

"Malacca Sultanate." This enlarged the exchange of goods, made for a further division of labor in economic functioning, the further intensification of the feudal structure that existed in traditional indigenous Malay society; and the rise and legitimation of hierarchical, bureaucratic organizations of officials with specialized functions patterned after the Hindu social system. These officials were provided with the means of preserving order and defending the state.

These innovations resulted in the establishment of what is called in Malay society a "Court Society," whereby the king's palace (Istana) became the center for political, economic, religious and intellectual activities and functions (Coedes, 1968).

The coming of Islam in the fourteenth, or probably as early as the latter part of the thirteenth century, and the establishment of new interactions between the Islamic traders and missionaries with the Malays resulted in the diffusion of Islamic cultural perspectives into Malay traditions which earlier had been influenced by elements of Hindu culture. However, in contrast both to the animism and dynamism of indigenous Malay culture, and to the hierarchical pantheism of Hindu culture, Islam brought a new conception with respect to the relation between man and God and in the interpretation of the universe and the cosmic order. The new Islamic culture offered an opening for the growth of a body of secular knowledge and permitted greater freedom of thought and inquiry. As a consequence, beliefs in spirits and supernatural powers that earlier pervaded Malay society, and the caste system which rested on the assumption that the celestial hierarchy was joined at its base by a lower human social pyramid, both were gradually adapted to the Islamic belief that God alone is all powerful and that beneath him all men are equal.

The art and literature which in the indigenous Malay and the Hindu cultures had played a vital role by symbolizing religious ideas and emotions declined in the face of Islamic austere theological doctrine. Stories dealing with Islam and tales of the great men and historic events of its rise, anecdotes of the Arabic way of life, all found their way into Malay cultural traditions.

Nonetheless, the religion of Islam was much modified into a Malay kind of Islam, combining Hindu-Buddhist Malay concept of fate, reincarnation and the mystical concept of unity with God. Hence, it is worth noting that both Hindu culture and, more importantly, Islamic culture brought about great changes in Malay society, including new meanings and values, particularly in the areas of political economy, social knowledge, law, language and literature, and social structure prior to British intervention.

The Role of the Intellectual and Man of Knowledge

In the ancestral Malay heritage, there was little awareness of the vast potentialities of man's intellectual capacities for learning and creating new knowledge. Persons were not encouraged to explore new domains of thought and experiment consciously with new ways of thinking. Thus, most knowledge, arts and philosophy were subsumed in a relatively stable intellectual legacy which persons received from their forefathers. This legacy was called adat (customary law). The most esteemed forms of knowledge concerned the spirits and supernatural powers and their relationships to the processes of the cosmic order. With the advent of Islam, detailed knowledge of Islamic culture and thought were considered important.

Out of this growing heritage, there emerged three major types of intellectuals and men of knowledge:

Firstly, were those who had extensive and specialized knowledge about the domain of the spirits and supernatural powers. This group was perhaps the most revered, influential and educated of all the men of knowledge. These spiritual leaders, along with the dukuns (magicians) who had complete information and understanding of the sacred liturgies, became the most important interpreters of knowledge in the total society.

Secondly, there were the professional story-tellers who could graphically relate the tales and legends of the ancient past. They were often found in the sultans' courts and performed during festivities.

Thirdly, with the advent of Islam, a new type of man of knowledge emerged. This was the ulama (religious teacher) whose functions were to propagate the teachings and disseminate the Islamic religion, thought and culture.

In summary, Malay social environs in pre-colonial days were a scene of great cultural activities stimulated and shaped by the interaction among Malay, Hindu and Islamic cultures. Over this long period, the changing Malay cultural heritage reflected the selective synthesis of indigenous Malay and foreign-introduced

Hindu and Islamic cultures. Hence, when Malay "traditional" society came into close association with the West toward the end of the last century, already a great variety of cultural genres had had a fundamental influence in that society.

British Colonialism: Scientific, Intellectual, and Politico-Economic Dependency in a Binational Third Culture

The establishment of British colonial rule in Malaysia in 1874 meant the beginning of the modernization and development of the country politically, economically, and socially. During the nineteenth century the British brought with them a limited range of new science and technology, economic enterprises, educational and social systems, beliefs and values, and slowly laid the foundations of a modern state by creating a modern bureaucracy, army and police, by instituting law courts, by developing communications--railways, post and telegraph, and roads--that would eventually help to sustain the colonial rule. Thus, British colonialism imposed upon the indigenous inhabitants a dependent and subordinate status, the collective status of a colonial people.

The Establishment of a Subordinate, Dependent Colonial Society, Many States and Multi-Ethnic Communities

The imposition of British colonial rule, with its underlying policy of divide et impera[4] (divide and rule) as a political

---

[4]It was a system of politico-administrative policy deliberately imposed by the British colonial government in Malaysia. Generally, the policy was aimed at achieving stability by introducing socioeconomic changes unevenly, on regions within the country, and

strategy, had far-reaching effects on the society. For the first time, Malaysia was fully integrated into the world capitalist system. More specifically, the new rule imposed upon the country an economically subordinate, colonial relationship, whose fundamental characteristics in some ways survive to this day. Under this new system the country became part of the metropolis-satellite structure which served as an instrument to exploit the surplus out of the satellites and to channel most of this surplus to the dominant metropolis.

The indigenous populations were primarily mobilized into the production of rubber and tin and later, of coffee, pepper and other goods for export. However, as these new commercial ventures were expanded, large-scale industries grew and the need for labor increased. The colonial government initiated the laissez-faire economic policy of free movement of capital. Under this new policy, Indian "indentured" laborers and Chinese emigrants entered the country in large numbers to work for the British colonial government in plantation industry, commercial enterprises, and public services.

Although the initial British control of the Straits Settlement (Penang, Malacca, Singapore) stimulated the beginning of modern Chinese and Indian migration to Peninsular Malaysia, the major flow did not take place until the latter part of the nineteenth century.

---

on ethnic, religious and other groups within the society. The changes commonly were more evident in the cities than in the rural areas, on the coast than in the hinterland, and among communities that--because of territorial location, traditional skills and habits useful to the new activities or a capacity for adaptation--were more able to adjust to new social and economic roles.

The causes of migration from China and India as well as the difficult working conditions to which these migrants to Malaysia were subjected have been the subject of considerable historical research (Blythe, 1975; Parmer, 1960; Jackson, 1961; Purcell, 1967; Sandhu, 1969).

Nonetheless, what is important to consider is that the arrival of the Chinese and Indians provided the colonial political economy a great opportunity and sufficient labor sources for the exploitation of local raw materials and minerals; for the development of agriculture for export; for the growth of trade and commerce; for the generation of capital and the production of foodstuffs and equipment to support the export economy. Besides, these new immigrants also contributed most of the necessary technology and social organization. More importantly, the arrival of these new immigrants also set the stage for the creation and development of new ethnic communities. Three major ethnic groups--Malays, Chinese, and Indians--eventually became the salient feature of Malaysia's social and political system.

With the establishment in Malaysia of a dependent colonial society and multi-ethnic communities, the British consolidated their rule over all the states. Between the years 1874 and 1914, all the states in Peninsular Malaysia--which included the Straits Settlement (Penang, Malacca, and Singapore), the Federated Malay States (Perak, Selangor, Negeri Sembilan and Pahang) and the Unfederated Malay States (Kelantan, Terengganu, Kedah, Johore and Perlis)--were brought under a federal union with complete British control over its politico-administrative structures and economic enterprises. Under this new political arrangement, the British secured hegemony and thereby completed the colonial system for Malaysia, consistent of a dependent-subordinated society of multi-states and multi-ethnic communities.

The Introduction and Development of the Western System of Education

Changes in the body of knowledge are of crucial importance in the development of societies and education is one factor that can bring about such changes. The creation of a system of Western education in a colonial society played a prominent role in stimulating and shaping the changes which took place in that society. Education is a key to the world outside the village and the state for the native society. Western education, or more precisely, English education, which was introduced by the British colonial government, could go a long way in providing the native society useful knowledge for restructuring the Malaysian society. Western education as designed by the colonial master was aimed at providing the "natives" with Western knowledge--primarily in the knowledge of arts, science, philosophy and literature of Europe, particularly of Great Britain. This is not surprising since the colonial government's conception of its educational task was more academic and literary than vocational. Secondly, it was aimed at ensuring the intellectual improvement of the natives in order that they could provide the colonial bureauracy and their various organizations with government officials, doctors, lawyers, engineers, and lower and middle-grade personnel. The colonial administration gave preference for jobs in their administration to persons who secured Western education and literacy.

The first English school was established in the country in 1816 at Penang. As more and more people became aware of the importance of Western education, and recognized that Western education had high market value in opening the way for new careers, the demand for such schools increased substantially. Accordingly, the colonial government made efforts to establish one primary and one secondary English school at each of the capital towns of the different states in the country. In addition, English-style schools were also established and maintained by missionary and charitable societies, principally the London Missionary Society, the American Methodist Mission and Roman Catholic Mission (Francis Wong Hoy Kee, 1972). These English schools were designed to prepare their graduates primarily for enrollment in Western-style colleges and universities at home and abroad.

The opening of these English-medium schools have had important implications for the modernization of Malaysian society. There is considerable evidence to show that the introduction of Western education, the widespread knowledge of the English language, literature and philosophy, the use of English textbooks, journals, magazines and locally published English newspapers have indeed drawn a new class of Malaysian into an entirely new line of social development. Along that line lie novel conceptions: progress, freedom of speech, criticism of authority, the questioning of accepted traditional values and dogmas, expression of universal values and individualism.

The growing familiarity with these concepts has brought a new spirit into Malaysian life. These newly learned, critical, rational and secular attitudes toward learning have given the people new aspirations, new opportunities and alternative life styles. Western education created a new kind of elite in Malaysia and these newly created elites--Malays, Chinese and Indians who were imbued with a new Western set of values--entered actively into the spread of new knowledge, new ideas and mode of learning a Western curriculum among the local people. They became agents of social change and provided their communities with the knowledge that could be utilized to modernize and develop the society.

The new learning experiences and knowledge attained established an all-Malaysian basis for its carriers and, thereby, helped to create a sense of national unity which had been unthinkable in the past. The English language became the lingua franca of the educated classes for almost all regions of the country. For the first time, Malay, Chinese and Indian elites came into existence who surmounted regional, parochial and linguistic barriers. Thus, the English education and language provided them with the commonality for sharing a feeling of nationalism. Some of these elites eventually became the leaders of the struggles for independence from the British and leaders in the fight against what they perceived as the "stagnation and backwardness" of the old society and culture. With all their combined knowledge and power, they attempted to change Malaysian society and culture in line with the progressive modern culture of the Western world.

Another influential characteristic in the establishment of Western education was that it was never distributed in a uniform fashion among the regions of the country and among the various segments of the population. Education was primarily an urban phenomenon and served basically the upper or middle classes of the population. Access to opportunities for Western education and, as a consequence, for jobs, was greater for the urban than for the rural sector of the population, for the rich elite and new middle classes than for the poor, for the Chinese and Indians than for the Malays, for the males than for females, and for the Western region of the country than for the Eastern region. These developments have had long-term social, economic and political implications. It engendered opportunities for some in the form of professional and scientific careers and jobs in the public services. In short, it hastened the growing side of the political economy. In addition, Western education also helped the rise and consolidation of the middle class comprised of scientists and other professionals in the Malaysian society.

The Transmission of Western Science and Technology

A model for the spread and diffusion of modern science from Western Europe--the original home of modern science during the sixteenth and seventeenth centuries--is provided by Basalla (1967). According to Basalla, there were three overlapping stages in the spread of Western science to other parts of the world. Phase 1 was the stage in which the areas outside Western Europe provided a major research site for European scientists. Natural history and the particular sciences related to the exploration of new lands dominated the scientific activities of this period. Phase 2 was the period of the spread of science to colonial countries and, finally, Phase 3 was the period of transplantation which was an attempt to generate an autonomous scientific tradition, institutions and culture in the new nations. While insufficient for dealing with the post-independent period in relationship to nation-building and the creation of a scientific community in an interdependent world, this three-stage model is useful enough to provide the time frame for understanding the historical process of diffusion of Western science into Malaysian society.

However, due to the scanty historical records available on the activities of European scientists in the Malay Archipelago, discussion on Phase 1 of the transmission process could not be provided here in detail.[5] The spread of modern science in Malaysia did not really begin until the onset of British colonial rule in 1874 and especially with the introduction of English education in the major towns and cities in the country.

---

[5]Perhaps indicative of the nature of such scientific activity during this period were the works of Sir Joseph Dalton Hooker and Alfred Russel Wallace. They did make some significant contributions to science based on their collecting ventures in Antarctica and the Malay Archipelago, respectively (Huxley, 1918; Wallace, 1960).

Most efforts at scientific learning and scientific activities, though limited during the colonial period, were done through the academic institutions--the English schools and colleges. For example, the curriculum in the English secondary schools, though biased toward the humanities such as the English language, English literature, history, art, geography and religion, also provided scientific subjects, particularly in mathematics, physics, chemistry and biology. Such heavy concentration on the learning of the humanities over the scientific subjects could be attributed to the colonial government which was deliberately aimed at preparing the natives for posts in an administrative bureaucracy; therefore, scientific instruction was done in the same vein: to prepare the students for government service. The establishment of the College of Agriculture in 1931, fourteen miles to the south of Kuala Lumpur, to provide diploma courses in basic agricultural sciences such as agricultural economics, animal husbandry, plant protection and farm management; the establishment of Technical College in 1942 in Kuala Lumpur, to provide diploma courses in architecture, civil engineering, electrical engineering, mechanical engineering, surveying and town and country planning; and finally, the creation of the University of Malaya in Singapore in 1949, consisting of three departments of Arts, Science and Medicine, completed the academic institutional base for the spread of colonial science in Malaysia.

It is important to recognize that these institutions, while providing education for the natives, were organized largely to satisfy the immediate administrative requirements of the colonial government which needed trained persons, engineers, administrators, technicians, artisans, medical doctors, etc., for government service and to provide the technical and professional manpower to explore and exploit the resources of the country. The colonial government did not actually develop a structured planning for the growth and development of a scientific community.

In addition to the academic institutions, the process of organizing scientific efforts and disseminating scientific information were initiated by the colonial government. The establishment of government-sponsored research institutes, such as the Malayan Rubber Research Institute, the Institute of Medical Research-Malaysia, and other government-run survey departments, were designed to focus on applied research particularly in resource assessment of the country. These research institutes were mainly directed by British administrators and scientists and supported increasingly by the Western-educated Malaysians with training in hard sciences. There were some contributions to natural history and the taxonomy of biological and zoological phenomena. The scientific efforts of individual scholars gained some local recognition with the establishment of the Malayan Branch of the Royal Asiatic Society, and the Malayan Nature Society. They aimed at providing a scholastic forum for British, foreign, and a minimum number of local scholars. Under these circumstances it can be construed that science in colonial Malaysia did not become a major public instrument for the development of the economic and social sectors of the country outside those of direct interest to the British colonial government. While there was a small native Malaysian scientific community, it consisted primarily of teachers in the university and colleges and in the government-sponsored research institutions and survey organizations.

In the ensuing years of colonial rule, these local scientific centers remained part of the larger colonial structure. Many of the senior scientists in the academic institutions and research institutes were recruited in Great Britain. Native scientists were regarded as less qualified to hold top scientific positions. They occupied subordinate roles in the occupational hierarchy, and therefore had little opportunity to exercise personal ability and to conduct independent research. As a result, what transpired in colonial Malaysia was the birth of a small group of local scientists whose orientations were toward the established scientific culture of Europe, but who could not share in the formal scientific network of that culture. Consequently, native scientists could not create great centers of scientific research in and on their country. They were more or less isolated from the world forum of scientific societies in other parts of the world.

Under colonialism these local Malaysian scientists and intellectuals were handicapped in their roles by the colonial system. However, some did join several political movements to fight for the country's independence from the British. With the attainment of independence, they were the first generation to sponsor changes in the social, political, economic and technological sectors and the post-independence modernization and development of the country.

Post-Independence Era: Change, Conflict and Vision of Progress

The Establishment of a New Nation State, a New Society and a New Patterning of Cross-Cultural Relationships

One of the crucial global events of the mid-twentieth century was the emergence of political independence of the majority of peoples in Asia, Africa and Latin America who in the nineteenth century had been brought under colonial rule. In this changeover, most of the world's inhabitants began to experience changes in their shared status, identity, hopes and dreams. Optimistic about the prospects for the near future of their peoples, these newly independent nations formed new organizations and programs and introduced the "know-how" and technology of the advanced industrial countries for their societal growth and change. A cardinal conviction of this period was that both political and economic development would assure a sound foundation for building a new society, culture and country, as well as a dignified level of living for the poor.

In the case of Malaysia, the withdrawal of British colonial rule occurred in 1957. Malaysia became independent and achieved a new status as a nation state, and its inhabitants assumed a new national identity. The new Malaysian society is now committed to development and change, in the sense of creating a future different from the past and one which continuously generates new values and cultures. In the process, the people have been collectively mobilized. They are, at least in principle, participants in the building of a new Malaysian society and culture. The new national leadership included a strong commitment to the modernization of traditional cultures, economic development, pervasive technological innovations, and the planning of varied programs to make for rapid changes in every sector of society. To fulfill these aspirations five successive five-year plans (1956-60; 1961-65; 1966-70; 1971-75; 1976-80) for national development have been formulated. New social structures have been formed around a complex of modernizing and development organizations.

These newly created development organizations included the establishment of many more institutions of higher education, to provide the institutional base for scientific, professional and high-level technical manpower training. Since independence there has been established a series of agricultural institutions aimed at serving the peasantry by providing extension, credit, marketing and research services.[6] To restructure society and to eradicate poverty, the new national government's strategy has been to set up public enterprises.[7]

With the attainment of political independence in the midst of an interdependent world community, a major new thrust for Malaysia has been to construct new patterns of cross-cultural relationships

---

[6]These institutions are: Federal Agricultural Marketing Authority, Farmer's Organization Authority, National Padi and Rice Authority, Agricultural Bank, Federal Land Development Authority, etc.

[7]These public enterprises are: Federal Industrial Development Authority, Malaysian Industrial Development Finance Berhad, Majlis Amanah Rakyat, Urban Development Authority, etc.

with both affluent and less affluent societies. The bilateral bonds which had circumscribed outside cultural contact to primarily Great Britain during the colonial period have been expanded in the post-colonial era to include multilateral contacts with all of the other developed countries (United States, Soviet Russia, Australia and New Zealand, Canada, France, Germany and Japan) and many of the less developed countries on every continent. These newer bonds are endowed with an extra degree of prestige and pride for the new nation by virtue of their representing to Malaysia's independence a symbol of their autonomy. The country, in principle, is free to participate in any form of cross-cultural relationsip. The co-equal norms of interaction and social relationships among the members of these different societies in direct contact and the fostering of mutual understanding between these independent but interdependent countries have been held forth as cultural values.

This enlarged scope of cross-cultural contacts accompanied by the exchange of visits among national leaders and other personages, the signing of treaties, the incorporation of foreign technical assistance endeavors, and the flow of Malaysian students and professionals to foreign countries in pursuit of knowledge have played highly visible and, sometimes, even decisive roles in the development of local capabilities and the modernizing of society. New linguistic codes have evolved to handle the delicate and sensitive aspects of inter-country relations and interpersonal encounters. Special organizations and programs have been formed around the technical, economic and, in some cases, military help given by the developed nations and international agencies to Malaysia.

These new patterns of cross-cultural transactions come about both through encouraging informal exchanges and by building formal networks through a diversity of instruments (bilateral, multilateral, regionally or internationally organized and private and public foundations). This period of growing cross-cultural transactions began on a major scale in the decade of the 1960s and has continued to expand in the 1970s. The field of education is a prime example.

Malaysia and her neighboring countries (Thailand, Singapore, Indonesia, and The Philippines) have organized a new regional grouping called the Association of Southeast Asian Nations (ASEAN). The Ad Hoc Committee on Science and Technology of this organization has organized projects in regional cooperation in education.[8] Participation by member states through their leaders, scientists and professionals in these projects provides opportunities and efforts for the discovery of new knowledge and for mutual exchange of knowledge, experiences and techniques among themselves that can contribute to the growth and progress of each member state and society. These new networks create new roles for the professionals,

---

[8]Among ASEAN projects, five stand out prominently, namely, the Regional Centre for Research Training and Post-Graduate Studies in Tropical Biology (BIOTROP) in Indonesia; The Central Co-ordinating Board of Tropical Medicine (TROMED) in Thailand; The Regional Centre for Education in Science and Mathematics (RECSAM) in Malaysia; The Regional Centre for Graduate Study and Research in Agriculture (SEARCA) in The Philippines; and The Regional English Language Centre (RELC) in Singapore.

scientists and technocrats, and perhaps new cultural identity, in their functions as mediators of knowledge.

The Combining of Cultures: Conflict and Congruence

British colonialism had created the structure of a plural society in Malaysia. There are indeed several ethnic strains in the population. Multi-racial and multi-cultural, the nation is readily divisible into four primary sub-cultures: the Malay, the Chinese, the Indian and the European. Of the four main sub-cultures, the Malay has the greatest degree of linguistic homogeneity. Except in the new states of Sabah and Sarawak, most people classified ethnically as Malays communicate and interact easily with each other, at least orally. The Chinese may be somatically homogeneous, but linguistically they are the most heterogeneous group: at least ten languages are represented, of which Mandarin (the medium of instruction in local Chinese schools) is one of the least common despite its great prestige as the national language of the Chinese. The Indians from the sub-continent plus Sri Lanka are linguistically divided into several different language groupings. They are further segmentalized by regional, religious and social class. Tamil, a Dravidian language, is, however, the most common native language among the Indian community in Malaysia. The European sub-culture includes not only recent arrivals from the West but also native Malaysian groups, such as the Eurasians and many others, e.g., Americans, Australians, and British, whose native language is English (Noss, 1967: 142-43).

While there is a common institutional framework in the form of national government and state governments, large segments of the society obviously do not share the basic socio-cultural heritage under which the society is organized. These multi-cultural ethnic groups may accept the government in existence as the only one which they have now, but they do not consistently view it as the only possible arrangement or as attuned to their specific legacy. The people are separated from the major thrust of the society's institutions by historical circumstances, by linguistic differences, by religious orientations, by social affinities, by political allegiances, by social class and by economic specializations. The presence of such a complex combination of cultures, and the ramifications of this superimposed segmentation have pervaded politics, economics, administration and education, thereby creating continuing tensions and conflicts of the first order in inter-ethnic relationships.

Almost any measure of socioeconomic status, whether education, occupation or income, reveals significant differences among the ethnic communities of Malaysia (Arles, 1971). Chinese and Indians have higher average levels of education and income than Malays. Too, a higher proportion of the employed population of Chinese and Indians is engaged in managerial, advanced technical, commercial, professional and other occupations of higher status (Hirschman, 1975: 19). Hence, the popular stereotype linking ethnic membership with class and occupation has become a dominant imagery in the minds of most Malaysians. It is often argued that the Malay community is the major political group in Malaysia, while the Chinese dominate the private sector. The Indians are dominant in the plantation industry.

Further reinforcing the cultural cleavages in the country has been the configuration of political parties. Following political independence and anticipating the extension of new governing powers, a number of political parties emerged, all tied in with ethnic alignment.[9] The emergence of these political parties expresses and perpetuates ethnic division and thereby challenges the conduct of a stable government in the setting of priorities for the social and economic development of the total society.

To mute the perils of ethno-cultural and political conflict, the Alliance Government involving the cooperation of three major ethnic groups and related political parties (UMNO, MCA, MIC) constitutes what Lijphart (1968) calls the "Consociational Democracy" model of governance, which is largely committed to system maintenance.[10] Despite the many sources of political tension in

---

[9]Some of the major political parties that were formed include: for the Malays, the United Malays National Organization (UMNO), and the Pan-Malayan Islamic Party (PAS); for the Chinese, the Malayan Chinese Association (MCA), the Democratic Action Party (DAP); and the Gerakan Raayat Malaysia (GRM); for the Indians, the Malayan Indian Congress (MIC), and other smaller political parties.

[10]System maintenance approach requires that the cultural group elites of the varying governing party, i.e., the Alliance government, (1) understand "the perils of political fragmentation," (2) be commited to the maintenance of the system through collaborative decision-making practices, and (3) be able to transcend the system's cleavages in doing so. This occurs when the elites have the ability to accommodate the divergent interests and demands of the subcultures (Lijphart, 1969: 216).

Malaysia which precipitated a major racial riot in 1969, there is a clear commitment of elites and intellectuals alike to the principles of inter-ethnic, economic and political cooperation. All three of the ethnic groups are represented in the national government's cabinet. Given the complexity of governing this segmentalized society, members of each ethnic group have actively or passively given considerable leeway to their leaders for the establishment of multi-ethnic cabinets and for the contrivance of public policies.

However, what is more important to understand with regard to the modernization of Malaysian society that cuts across ethnic lines in this present period is the growth of a modern culture. According to Shils, this culture

> involves an appreciation of the validity of science and of a rational, nonmagical approach to the problems of individual life and to social organizations; it involves knowledge of some of the main works of modern culture in science, literature, history and a continuous contact with some stream of modern culture (Shils, 1972: 376).

Higher Malaysian civil servants, members of the old aristocracy, politicians, university teachers, scientists, engineers, lawyers, physicians, businessmen, journalists and armed forces personnel are among the major participants in the modern culture. They are playing a vital role in the implantation of the seeds of modernity in the society and are occupying central positions of influence in society, in the higher civil service, in the law courts, in the leadership of political parties, in the universities, in the research institutions, in the mass media, in the armed forces, in the private sector and in other important development organizations in the country.

In the process of relating their respective ethnic groups or segments thereof to each other within the national society and with those outside the national society, these persons oftentimes assume the role of "cultural brokers." They commonly are involved in nation-building, in the diffusion of a national culture to the countryside, and in the practical politics of accommodating to the demands of local interest groups for their claimed share of the new opportunities and resources related to science and technology. In other words, they are "men-in-the-middle" of intersecting societies, with occupations or professions that are part of the modernizing, developing, nation-building institutions. Their life style and social relationships, their self-identification are modern; they have little traces of their traditional culture in their public outlook and role. Apart from this modern culture there is the presence of a traditional religious-philosophical culture. The carriers of this traditional culture include the priests, monks, practitioners of indigenous or folk medicine, religious gurus, and old aristocratic elites. They scarcely respond in any way to the norms of modern and Western cultures. The coexistence of these two modern and traditional cultures, as well as the presence of varied sub-cultures in Malaysian society, has indeed resulted in complex internal differentiation and combination of groupings and poses difficulties in regard to social and economic development of the country as a coherent whole.

The Creation of Universities: Institutions for Training Scientific and Technical Manpower

The national leaders of Malaysia are determined to create a modern government, economy and society without further delay. They articulate an urgent need and evince in their behavior an eager desire to make a gigantic leap across time, to bypass slower and more "common" processes of economic and technological growth by placing science at the service of the political economy in order to develop an intermediate technology--a system of improved agriculture, of industrial expansion, of health and sanitation and of education and training. More generally, they aspire to foster the social and intellectual bases of a vigorous modern economy and society by political means. Hence, a strong national capability for creating modern knowledge in science and using science-based technology is considered a vital element in accelerating the socio-economic progress of the country. To produce the leaders in science who can fill the country's high-level manpower needs, institutions of higher education have been created to train within the country, scientists, technocrats, administrators and professionals. This new aspiration is, in fact, one of the main objectives of the national development planning, in which the functions of higher education are clearly highlighted.

The four major objectives of education and training set forth in the Second Malaysia Plan, 1971-75, are:

a. Consolidation of the educational system to promote national integration and unity;

b. Orientation and expansion of education and training programs towards meeting the manpower needs of the country;

c. Improvement of the quality of education for the building of a progressive society oriented towards modern science and technology; and

d. Improvement of the research, planning and implementation capability to meet the above objectives.

Thus, apart from the overriding socio-political concern for the promotion of national integration and unity, the production of trained manpower in the fields of science and technology is considered the primary objective of education for the country. To meet the need for scientific and technical manpower, the first University of Malaya at Singapore was established in 1949, providing courses in medicine, arts and science. As the country progressed, moves to open a new branch of the university in Kuala Lumpur were initiated in 1957. Although the Federation of Malaya (Peninsular Malaysia) became independent in 1957, the University of Malaya continued to exist as a single university with two divisions, one each in Singapore and Malaya, until 1962. Moves to establish two separate national universities in the two territories were started in 1960 and legislation to this effect was accepted by the two countries in 1961. The evolution of the University of Malaya, Kuala Lumpur, has been one of rapid development. In 1959, there were 323 students, but in the academic year beginning in 1974, the total enrollment had increased by more than 25-fold to 8,330 (Kee Poo Kong, 1976: 6). Today, the University is in a period of consolidation and the maximum student enrollment will be maintained at about 8,300. The

University offers degree courses in Arts, Dentistry, Economics and Administration, Engineering, Law, Medicine, Science and Chemical Technology. Any further development will take the form of vertical expansion in the direction of post-graduate studies and advanced research.

However, the interplay of economic, cultural, and social as well as political factors in the post-independent period has resulted in the proliferation of institutions of higher education. The upsurge in higher educational opportunities has been guided, in part, by the government's "Report of the Higher Education Planning Committee," published in 1967. This five-year investigation reviewed the arrangements in Peninsular Malaysia for higher education and made recommendations for the development and improvement in the light of the foreseeable future and financial resources of the country.

The first university to be established after the publication of this report was Penang's University of Science, Malaysia (Universiti Sains Malaysia), originally named the University of Penang, in June, 1969. The primary focus of this institution is a curriculum of study in the basic and applied sciences (biological, chemical, physical and mathematical) with some concentration in Comparative Social Sciences, Cultural and Community Studies and Education. A year later, in 1970, another university was established in Kuala Lumpur, known as the National University of Malaysia (Universiti Kebangsaan Malaysia). It incorporated the Muslim College which was the earliest institution of higher Islamic education in

Malaysia. In contrast to the other universities which employ English, it uses Bahasa Malaysia as the medium of instruction. At present it offers courses in Islamic Studies, Humanities and Social Sciences, Economics and Commerce, Science and Medicine. The National University will be moving to its new and permanent campus in Bangi, some 20 miles from the federal capital, by 1980.

In 1971, the University of Agriculture of Malaysia (Universiti Pertanian Malaysia) at Kuala Lumpur became the third university to be established within a short period of three years. It started offering degree courses as a result of the amalgamation of the College of Agriculture at Serdang with the Faculty of Agriculture of the University of Malaya. The University of Agriculture offers degree courses in Agriculture, Forestry, Veterinary Medicine and Animal Science as well as Resource Economics and Agro-Business with courses in Agriculture, Home Economics and Basic Science given at diploma level. Finally, in 1972, the University of Technology in Kuala Lumpur (originally named Technical College) was established. This university offers both three-year and five-year courses leading to a college diploma or degree in, among other things, Architecture, Civil, Electrical and Mechanical Engineering, Petroleum Engineering, Surveying and Town and Country Planning.

The establishment of these universities within a brief span of time have suddenly expanded the range of opportunities to many Malaysians, particularly the less privileged segments of the population. There has been a doubling in student enrollment in the five academic institutions within the five-year period 1970-74 (see Table 8).

TABLE 8.--Full-Time Student Enrollment at Five Malaysian Universities, 1970-74.[11]

Institution	Year				
	1970	1971	1972	1973	1974
Total enrollment at all levels	8,208	10,566	13,183	14,575	16,064
University of Malaya	7,777	8,545	8,748	8,519	8,330
University of Science	262	670	1,122	1,483	1,794
National University	169	532	996	1,486	1,977
University of Agriculture	--	819	1,091	1,589	2,214
University of Technology	--	--	1,226	1,494	1,749
Percentage of increase in enrollment	--	28.7	60.6	77.6	95.7

For example, in 1970, the total enrollment of the five universities was 8,208 students. In contrast, in 1974 the enrollment was increased to 16,064 students, making an increase of 95.7 percent.

In addition to domestic student increments, the number of Malaysian students going abroad has increased since independence. There were an estimated 19,962 Malaysian students--sponsored and private--undertaking a variety of courses in science, technology, social sciences, humanities, and law in foreign institutions in

[11]Figures provided by Administration, University of Malaya, University of Science, The National University of Malaysia, University of Agriculture and University of Technology.

1971-73.[12] This increase is in part a result of the great increase in opportunity for educated Malaysians in governmental and para-governmental agencies; it is also a result of the increased number of scholarships and grants by Malaysian and foreign governments, universities and related institutions. In the past, those sent abroad for higher studies came primarily from or were sponsored by the richer section of the Malaysian population, namely, civil servants, businessmen, and landowners who believed in the superiority as well as in the social and economic advantages of foreign, particularly British, education. This group still exists and contributes to the flow of students, but it has been very far surpassed by the children of persons of middle and lower-middle class status.

Of the total students enrolled in home and foreign universities in 1973--34,537--it was found that more than half (57.8 percent) were studying in institutions abroad and 42.2 percent in home-based universities. This reflects the trend that more Malaysian students are found studying abroad for their professional education and training than in their home country. It is, therefore, evident that the contributions of Malaysians educated in the West seemingly are more important to the making of modern Malaysia. Their leadership in political as well as in social, administrative, and scientific and technical spheres are important and have been well established.

---

[12]Mid-Term Review of the Second Malaysia Plan 1971-75, 1973, p. 199.

Briefly reviewd, then, insofar as it is a proper role of a university to serve society in a direct and immediate manner--to act as an instrument of change--the Malaysian university is far better equipped to perform this role in the '70s than it has been in the past. And there is little doubt that it undertakes to spread knowledge through courses and seminars, and also to make known, through publications, the scientific and intellectual achievements of its members; and the most significant works of both Malaysian and world-wide culture. Lastly, it undertakes to stimulate and encourage activities which will help, in any degree, the social advancement of the country.

Malaysian Perspective on Science and Society in Relation to Modernization, Development and Progress

Beginning with independence, Malaysia continues to experience dramatic changes. The overriding objective of the national policy is the promotion of national unity through the two-pronged strategy of (a) eradicating poverty by raising income levels and increasing employment opportunities for all Malaysians, irrespective of race; and (b) accelerating the process of restructuring Malaysian society to correct economic imbalance, so as to reduce and eventually eliminate the identification of race with economic function.

In the light of this development strategy, Malaysia now envisages science and technology at large, as instruments for the transformation of society. There is general recognition that social, economic and human development require many persons to have a scientific and professional education and training. Thus, in 1971-75, an estimated Malaysian 733.10 million dollars was allocated for public development and expenditure for education and training. This was approximately 7.8 percent of the total development expenditure for this period. And further, of this total, 111.60 million dollars (15.2 percent) was designed for higher education at the level of the universities.

This suggests, then, that in the post-independence period, higher education--scientific, technical, professional and humanistic--were all elevated, although not uniformly. In this period disciplines such as life-medical, life-general, law and economics which had been esteemed became more esteemed; fields which had been taken lightly such as physical sciences, engineering, agricultural sciences and branches of social sciences--sociology, psychology, political science, anthropology, communication arts and commerce--are now treated more seriously.

Besides, extensive research activities have also been developed in different research centers--the universities, research institutes,[12] and the specialized units in the various ministries of the government. It is conceivable that these scientific activities will further generate the development of science in Malaysia.

---

[12]The following represent some of the main research institutes in Malaysia: the Rubber Research Institute (RRI), Malaysian Agricultural Research Development Institute (MARDI), Institute of Medical Research (IMR), Standard and Industrial Research Institute Malaysia (SIRIM), Forestry Research Institute (FRI), and Tun Ismail Atomic Research Center (TIARC).

There are now many new roles for scientists and intellectuals in the country which had been less visible before independence. Demands for professional and intellectual services are increasing rapidly in Malaysia. However, in addition to the modernizing functions performed by these professionals in their work-roles, there are publishing firms, public library services, television, and daily and periodical press which have been established to disseminate knowledge and information in the larger society.

Thus, recognizing the values for an integrated approach to the planning and development of Malaysian society and its culture and of the input of science and technology, a new National Council for scientific Research and Development (NCSRD) was established in 1975. With the creation of this council, it is expected that a comprehensive and coherent science policy for modernization and development in the country will be formulated.

Given this social heritage and recent mode of development in Malaysia, the question of this study then turns to the characteristics of the Malaysian academic scientific community and their professional activities at this point in time.

CHAPTER III

THE SOCIAL ORGANIZATION OF RESEARCH ACTIVITIES

Scientific research in Malaysia is at present carried out largely in public institutions like the universities, government-sponsored (but semi-autonomous) research institutes, as well as in some government departments. However, approximately 85 percent of scientists engaged in research are to be found in the institutions of higher learning. The community of practicing scientists is, indeed, a small one, totaling 13,768 persons in 1973, especially when viewed in relation to the population of the country. This chapter describes for our sample their research activities and the related factors affecting their activities. The specific emphases will be on: (1) Scientists' involvement and their choice of research problems for research. Issues related to time spent in research, factors influencing choice of research problems, types of research in which scientists are engaged in, basic vis-à-vis applied, and sources of funding for research will be analyzed. (2) Scientists' accessibility to facilities for conducting research, particularly in the physical and social domain. (3) Scientists' specific research projects, their involvement in individual or collaborative research activities. (4) Incidence of scientists' research productivity and the publication outlets of their research work--domestic and foreign.

Structure of Involvement and Choice of Research Problem

Time Spent in Research

All Malaysian universities expect their scientists will contribute to knowledge and the advancement of science. They, therefore, take steps to ensure that the teaching and other academic responsibilities will not be such as to leave faculty with insufficient time to follow their own lines of investigation. Our purpose here is to examine in reality how much time is apportioned by scientists to research in their total endeavors and their own perceptions as to whether or not sufficient time is available to them to participate actively in research.

Our sample scientists were asked the extent to which time is important and available to them to do research. While 88 percent report that time is an important dimension in their capacity to do research, only 29 percent consider that enough time is actually available to them to carry out their plans for research. Those who feel they are not hampered by time restrictions are predominantly in life-general and social sciences. In contrast, 59 percent indicate that they seldom have sufficient time to participate actively in research. They are mainly in physical sciences, engineering, life-agriculture and life-medical sciences. Thus it is evident that nearly nine out of ten scientists note the importance of having adequate time for research but scarcity of time is a major constraint which limits their effective role as researchers. Apparently, this lack of time is caused by their involvement in teaching, administration, committee service and, in the case of medical scientists, clinical duties and the treatment of patients. For example, one out of two scientists in the sample is heavily involved in administrative duties either as chairman of department, dean or deputy dean of faculties, master of residential colleges, or other administrative functions.

Table 9 shows the distribution of scientists by their administrative functions.

TABLE 9.--Distribution of Scientists by Administrative Functions.

Administrative Function	Number	%
Total	80	100.0
Non-administrator	40	50.0
Deputy vice-chancellor	1	1.2
Dean of faculty	10	12.5
Deputy dean of faculty	5	6.3
Chairman of department	20	25.0
Master of residential college	2	2.5
Editor of journal	2	2.5

A majority of these scientists-administrators are senior faculty in their institutions and eminent scholars in their own fields. A large proportion, particularly those in the primate university, are in the middle years of their careers--with respect to age, previous research experiences and length of time in the organization. They have reached senior academic positions with the rank of professor or associate professor. They are expected to provide leadership in the scientific community. This entails supervision of subordinates and students. However, since they are heavily involved in full-time routine administrative work, in planning and decision-making, they have less time to fulfill their potentialities as creators of knowledge. They may become competent administrators but certainly this will be at the expense of reducing the ability to remain active producers of knowledge. There is not much choice for scientists. The overall university research system is relatively weak, since the major organizational structure puts emphasis on teaching of undergraduates and not on research-oriented graduate studies. Moreover, research positions as a system of vertical mobility have not been created independent of administrative positions in the university system. Therefore, any form of upward social mobility that scientists can aspire to is primarily academic administrative positions. Moreover, in practice, for academic promotion, oftentimes professional competency and high productivity in research are considered less important than such factors as seniority, community services, academic degree and, in some cases, ethnic background.

Under these circumstances, it is common for many scientists to aspire for administrative positions that entail power, authority and status. By holding these positions they will have social credibility for establishing links within their own organization, and with scientific and professional communities in the country as well as abroad. Indeed, these positions enhance their opportunities for building links with policymakers and senior science administrators in government agencies, business, local communities and private foundations in the country and with comparable foreigners abroad. These academic administrative positions limit the scientists' potentialities of becoming productive researchers and creators of knowledge. But it provides them the identity as "experts" in the public eye, thereby allowing them to function as network brokers for obtaining support for the scientific activities of the members of their group.

Scientists were asked to indicate the specific amount of time they actually apportioned to research. Table 10 gives the distribution of time devoted to research by major fields of science.

TABLE 10.--Major Area of Science by Time Apportioned to Research.

Major Area of Science	Time Apportioned to Research							
	Total		10% or Less		25%		50%	
	N	%	N	%	N	%	N	%
Total	80	100.0	22	27.5	46	57.5	12	15.0
Physical	12	100.0	4	33.3	6	50.0	2	16.7
Engineering	13	100.0	4	30.8	7	53.8	2	15.4
Life-Gen.	14	100.0	0	0.0	10	71.4	4	28.6
Life-Agr.	13	100.0	4	30.8	6	46.2	3	23.1
Life-Med.	13	100.0	6	46.2	6	46.2	1	7.7
Soc. Sci.	15	100.0	4	26.7	11	73.3	0	0.0

Approximately 85 percent spend a quarter or less of their time on research. The majority of them spend most of their time on teaching and on other non-research activities. The one exception consists of the 15 percent who divide their time equally between research and teaching or other activities. Among these, two are in the physical sciences, two in engineering, four in life-general, two in life-agriculture and one in life-medical. Generally, there are not remarkable differences among scientists with regard to the total time apportioned to research. However, if we take the time apportioned between 25 percent and 50 percent to research as an arbitrary indication of active participation in research, then clearly persons in life-general seem to be the most active of all the scientists. All of them either spend a quarter or more of their time on research. They are the least involved in administration; of the total 14 life-general scientists, only two (14.3 percent) are administrators and both are chairmen of departments. Therefore, besides teaching, they have ample opportunities and time to pursue their own research. A large proportion of scientists in all the other disciplines--physical, engineering, agriculture, medical and social sciences--are heavily involved in administrative duties and, therefore, have less time for research. Accordingly, the least amount of time apportioned to research is by medical scientists. Six out of 13 (46.2 percent) in the sample spend 10 percent or less, and another six (46.2 percent) spend a quarter of their time on research. Only one medical scientist was found to spend half of his time on scientific research. Besides teaching and administrative duties, they often have clinical duties.

In sum, work of scientists in the academic institutions is confined largely to teaching and administrative duties. The organizational structure supports this arrangement. Some scientists carry routine administrative responsibilities, planning, decision-making, recruiting, budgeting and, for the medical scientists, clinical duties. Others find a heavy teaching burden--on the average, 15 to 20 hours a week--an obstacle to creative research. In fact, for the majority of scientists the scarcity of time is a true situation and not a kind of defense mechanism for scientists to hide their lack of involvement in research, scholarly productivity and intellectual vocation behind a respectable cloak. Obviously, scientists are heavily engaged in instructing a major part of the future intelligentsia and the professional, technological, managerial and teaching personnel who are essential for the implementation of the national development plan.

Consequently, given the present internal structure of the university, with the principle of financing built around purely didactic categories (the institution of professorial chair, straight line curricula, emphases on the production of manpower), the balance of teaching and research will remain heavily on teaching. Research careers as opposed to teaching careers have yet to be created in the university system.

Factors Influencing Choice of Research Problem

Besides time available, the scientists' involvement is influenced by their choice of research problems. Autonomy and independence are basic to the satsifactions they find in their research work. However, they are not perceived ends in themselves; to the individual they mean the opportunity to pursue his own interests by his own methods. The question asked the scientists was: Do scientists work on problems which they consider "their own"? Overall, nine out of ten persons (97 percent) work most of the time on problems which they consider their own initiated choice. In contrast, only 3 percent work on problems that were recommended either by private industry or international organizations. Of these, one, a physical scientist, is working on a problem suggested by a private industry and two, one medical and one social scientist, are working on problems that were proposed by international organizations. None is involved in any studies at the request of the national government.

However, even though nearly all the scientists regard themselves as working on problems which they consider their own selections, in reality, there are more latent factors that influence their current choice of specific research problems, and there are great distinctions on this score among scientists. Table 11 shows that of the total sample, seven out of ten persons (71.3 percent) indicate that their current research projects are perceived as important to government policymakers and to the future of the

TABLE 11.--Factors Perceived Influencing Scientists' Choice of Research Problem by Major Area of Science.

Factors Influencing Choice of Research Problem	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agr.		Life-Med.		Soc. Sci.	
	N	%[a]	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	12	100.0	13	100.0	14	100.0	13	100.0	13	100.0	15	100.0
Continuation of problem started in grad. school	31	38.8	6	50.0	9	69.2	5	35.7	4	30.8	2	15.4	5	33.3
Problem modified to suit local conditions	17	21.3	2	16.7	3	23.1	3	21.4	3	23.1	0	0.0	6	40.0
Recommended by Malaysian senior scientists	5	6.3	0	0.0	2	15.4	1	7.1	1	7.7	0	0.0	1	6.7
Recommended by private industry	1	1.3	1	8.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Direct concern to policy makers and important to future of country	57	71.3	7	58.3	5	38.5	10	71.4	13	100.0	10	76.9	12	80.0
Embark on new line of research	24	30.0	5	41.7	4	30.8	5	35.7	3	23.1	4	30.8	3	20.0
Availability of funds, facilities for specific studies	17	21.3	4	33.3	2	15.4	3	21.4	2	15.4	3	23.1	3	20.0
Recommended by foreign and international organization	6	7.5	0	0.0	0	0.0	0	0.0	0	0.0	2	15.4	4	26.7

[a]Does not add to 100.0 percent because sample of scientists chose more than one factor influencing the choice of research problem.

country. Next, almost two-fifths (38.8 percent) report that their present studies are a continuation of the same problems which they started in graduate school overseas. There are some other interesting sidelights. Less than a third (30 percent) have embarked on a new line of research and less than a fourth (21.3 percent) have modified their research interests in order to fit local conditions. In addition, there are some others (21.3 percent) who are working on projects because there were funds and facilities available to enable them to carry out specific studies in which they have an interest or are working on projects which had been recommended (whether or not they were funded) by foreign and international organizations (7.5 percent) or by senior Malaysian scientists (6.3 percent). Only one scientist in the sample was found to be working on a problem recommended by private industry. By scientific disciplines, among those who perceived that their current studies are important to government policymakers and to the future of the country, predominant are life scientists--agricultural (100 percent), medical (76.9 percent) and general (71.4 percent)--and social scientists (80 percent). In contrast, the physical scientists (58.3 percent) and engineering scientists (38.5 percent) are less certain that their current research work is important to the government and the future of the country.

The physical and engineering scientists are more likely than others to continue working on the same scientific problems which they started in graduate school overseas (50 percent and 69.2 percent, respectively). A partial explanation for this is that probably there are fewer sectors in the country to which to relate their research activities. It may also be due to the fact that they specialize in studies that are less development-oriented and, therefore, inversely receive little public recognition and support for their work. If this is so, then, it is expected that they have little choice but to continue working on old research problems. However, some of them in these fields have modified their focus of research and/or have embarked on new lines of research. For these scientists, it is expected that their research work is of direct concern to policymakers and other agencies. Forty percent of the social scientists have modified their research to fit local conditions, whereas none of the medical scientists and less than a fifth of the other disciplinary areas have done so.

Great variations, therefore, exist in the factors influencing the choice of research problems. Needless to say, one factor remains dominant, that is, six out of ten (61.2 percent) are no longer working on the same problems that they started in graduate school abroad. They have begun to venture on new lines of research, that they have initiated themselves or on the recommendation of other people or agencies. Inasmuch as their researches are on new lines and for at least one is self-consciously tied to policy questions on local situations, certainly it will have some impact on the character of the scientific community in Malaysia and the larger society in the country. The initiative taken by these scientists to engage in studies on new problems suited to the circumstances in the country illustrates that the end product of their work can be potentially useful to some segments of the society.

A significant relationship occurs between generations and factors influencing choice of research problem. Scientists in the first generation, those who have had their bachelors degree education and training before 1957, are no longer working on problems they started in graduate school. They have embarked on new lines of research or they are now working on projects which are of direct concern to policymakers and important for the future development of the country. Given their senior positions in both the academic and scientific hierarchy, they have adjusted their scientific activities to the predominant concerns of a modernizing society.

More distinctive patterns exist between the second, third and fourth generations of sample scientists, respectively, who completed their bachelors degree training after the country's independence in 1957. A majority of persons in these generations have continued working on problems that they started in graduate school. This is roughly two out of three of the second generation (64.3 percent), and one out of three of the third and fourth generations (38.3 percent and 36.4 percent, respectively).

Of those who work on studies which they perceive to be of direct concern to government policymakers and important to the society, predominant are scientists in the first, second and third generations (87.5, 71.4, and 74.5 percent, respectively). Apparently, the length of time since their return from their education and training overseas has made it possible for them to settle down in their professional activities and to relate their studies more directly to the problems that concern the country. In addition, the more eminent scientists--one in the first, two in the second and three in the third generations--are working on problems that were suggested to them by foreign and international organizations, i.e., Ford Foundation, World Health Organization and UNESCO. In contrast, no member of the fourth generation has been approached yet by foreign and international agencies to work on a specific problem.

Among those who have embarked on new lines of research, percentagewise there seems to be no great difference between generations. Nonetheless, despite these various factors which the scientists feel influence their choice of research activities, generally they are involved in two types of research, basic and applied.

Research Paradigm: Basic and Applied

The distinction between basic and applied research is a matter of great complexity. It is not always possible to make a clear-cut distinction. For the purpose of our study, the two orientations can usually be separated with respect to our sample's primary concern. Basic research is differentiated from applied research in the sense that basic research is aimed at a fuller knowledge or understanding of the subject matter of the study, rather than a practical application thereof. In basic research, it is more likely that scientists have no specific policy or programmatic-related objectives but are free to follow their scientific curiosity wherever it might take them. Whereas in applied the scientists are motivated by a desire for the outcome of the research to be useful whether for profit or for humanitarian purposes, and whether or not the results are actually used.

In the interview, our sample were asked about the types of research that have played a great part and best described their own research activities. Overall, more than half (58.8 percent) of them reported that from their perspective, they perceived themselves as engaged in applied-oriented rather than basic-oriented research. This holds true irrespective of their gender, ethnicity, generation, level of education and university affiliation. Table 12 shows that 33 scientists (41.3 percent) label their research goals as basic-oriented and 47 (58.7 percent) as applied-oriented.

TABLE 12.--Major Area of Science by Orientation to Research Goals.

Major Area of Science	Types of Research					
	Total		Basic		Applied	
	N	%	N	%	N	%
Total	80	100.0	33	41.2	47	58.8
Physical	12	100.0	7	58.3	5	41.7
Engineering	13	100.0	5	38 5	8	61.5
Life-Gen.	14	100.0	8	57.1	6	42.9
Life-Agr.	13	100.0	3	23.1	10	76.9
Life-Med.	13	100.0	3	23.1	10	76.9
Soc. Sci.	15	100.0	7	46.7	8	53.3

Approximately two-fifths (41.2 percent) of the scientists view themselves as engaged in basic research. On further examination we find that in describing their work orientation as "basic" often it is directly relevant for the development of knowledge in the respective disciplines in Malaysia, but may be tangential or fringe to the central thrust of a larger international science collectivity. Such knowledge may indirectly be of international scientific value eventually, but it is not part of the global major area of interests. Examples of such work are those dealing with genetical and morphological investigation of Malaysian native livestock and survey of blood and tissue parasites of "Orang Asli."

However, there are researches underway which may have greater direct impact in the international circles than those studies mentioned above. These studies involve work in electron microscopy of trophoblast and ovarian cancers, taxonomy of Malaysian fungi, natural products chemistry, and interception studies in lowland forests in Malaysia.

Roughly three-fifths (58.8 percent) of the sample are oriented to applied research in which they envision their present work as being of immediate use in Malaysia. Examples of such work are those dealing with psychiatry, e.g., depressive illness, epidemic hysteria; agriculture, e.g., genetic studies in cattle production; biological, e.g., orchid physiology, genetics and enzymes of food, plant genetic resources and conservation, parasite serology; economics, e.g., labor utilization and public enterprises in Malaysia; and sociology and anthropology, e.g., regional population mobility, administration and family planning services in Malaysia and folk narratives.

The disciplinary groups that are now oriented to applied research are primarily medical life scientists (76.9 percent), agricultural life scientists (76.9 percent), and engineering scientists (61.5 percent). They envision that science is meant to serve many ends, of which the search for "absolute" truth and new knowledge is important, but not the only objective. For most of them, they prefer that the training, methods and factual knowledge gained by scientists be directly related to areas of public needs. The application of knowledge is for them as important as the creation and gaining of new knowledge. The fields of medical, agricultural and engineering research seem clearly to have greater relevancy to the current development of society and are now effectively used in the formulation and application of measures to upgrade the health, agricultural and technological capability of the people and country. This provides them with a strong motivation to select problems with practical values and potential relevancies in mind. The social scientists (53.3 percent), the general life scientists (42.9 percent), and the physical scientists (41.7 percent) are moderately involved in applied-oriented studies. Some scientists in these fields are found to have less opportunity to relate to practical-oriented studies; they lack sectors--organizations or professions--that are ready to support or accept the product of their research findings.

Two-fifths (41.2 percent) of the sample are moderately oriented to basic research. Of these the most committed are the physical scientists (58.3 percent), the general life scientists (57.1 percent) and the social scientists (46.7 percent). Our in-depth interview suggests that some of them, particularly those in physical and general life sciences, view their work as not having any foreseeable technological or other applied consequences. They believe that a pure scientist must not be deflected from pursuing fields of study by worrying about social consequences. They suggested that a researcher cannot possibly anticipate the practical derivatives of his work and, therefore, cannot be held responsible for the potential use to which his discoveries might be put. They strongly feel that the search for new knowledge in their own specialized field is important. In sum, a majority of scientists in physical and life-general share the norms that encourage the open-ended exploration of new ideas, which is incorporated in the concept of basic research. One eminent physical scientist carefully summarized the argument:

> I feel that as our society progresses scientifically, the search for absolute truth and new knowledge in science is important. The scientist should have freedom to choose his own route to the solution of problems, and consistently gain new knowledge. Otherwise, our science will not be able to cope nor compete with those of the advanced countries. Our society will remain backward in pure scientific productivity. I do not bother about its practical values, nor about prestige. What really matters is my own scientific achievement and self-satisfaction.

The general assumption among scientists, therefore, is that their spectrum of research interest ranges from "basic" at one end to "applied" at the other. They recognize and value the ethos of autonomy in their scientific work, but at the same time are very much aware of the external forces in society bearing down upon it. While some are devoting themselves to pure basic research, even they cannot totally disregard the cultural milieu of the larger society in which they are necessarily involved through their relationship to the wider community. This has led some to concentrate on applied research, too, which is also capable of developing new ideas and principles of its own.

Sources of Funding for Research

We next examine the sources of funding for the specific basic and applied studies scientists have been working on within the last three years. The scientists were asked to identify their recent research projects according to whether they thought of them as being basic, applied, or mixed basic and applied. Table 13 shows this distribution and indicates the sources of funding.

Of the total 170 research projects in which our sample of scientists have been involved in the last three years, they classify 56 projects (32.9 percent) as being basic-oriented, and 100 (58.8 percent) as applied-oriented, and 14 (8.3 percent) as a mixture of both. Of these studies, three out of four (76 percent) are funded by the scientists' own institutions and almost one out of four (24 percent) are financed by external domestic and foreign sources. The national government, usually acting through the Ministry of Education, allocates financial aid to each institution annually. Each university in turn reallocates the money to different faculties and

TABLE 13.--Sources of Funding of Research Projects of Scientists in Last Three Years.

Source of Funding	Type of Research							
	Total		Basic		Applied		Basic/ Applied	
	N	%	N	%	N	%	N	%
Total number of projects	170	100.0	56	32.9	100	58.8	14	8.3
Domestic								
Total number of projects	138	100.0	47	34.1	79	57.2	12	8.7
Own institution	129	100.0	46	35.7	72	55.8	11	8.5
Malaysian government	4	100.0	1	25.0	3	75.0	0	0.0
Malaysian private industry	4	100.0	0	0.0	3	75.0	1	25.0
Malaysian research institute	1	100.0	0	0.0	1		0	0.0
Foreign								
Total number of projects	32	100.0	9	28.1	21	65.6	2	6.3
International organizations	14	100.0	7	50.0	6	42.9	1	7.1
Foreign foundations	6	100.0	0	0.0	6	100.0	0	0.0
Foreign governments	10	100.0	2	20.0	7	70.0	1	10.0
ASEAN (Association of Southeast Asian Nations)	2	100.0	0	0.0	2	100.0	0	0.0

units for different purposes--staff salary, research and development and so forth, without any form of direct intervention from the government. Having financial support from his own institution does not obligate the individual to submit his research results, whether basic, applied, or a mixture, to any particular group beyond the scientific community.

Of the one-fourth of the projects that are funded by external sources, 5.3 percent are domestic and 18.8 percent are foreign. Indeed, it is irony that of the external sources of support for research by Malaysian academic scientists, a higher proportion comes from foreign than domestic sources. And the fact that only 9 out of 138 projects are funded directly by external sources inside the country obviously reflects the scarcity of support for funding from sources outside the government-university system in the country. This reveals the limited participation on the part of professional groups and its agencies, business, local private industry and other segments in the country in contributing to the growth and use of the nation's academic-based scientific research capacity. As indicated in the beginning of this chapter, scientific ressearch in Malaysia is carried out primarily in public institutions and approximately 85 percent of scientists actively engaged in research are to be found in the universities. As a collectivity, in addition to engaging in their own research, most of them indicate that they are constantly in touch with recent developments in the world-wide scientific literature, and that they are excellent sources of information on current developments in their own fields of specialization. Yet, overwhelmingly, their skills and knowledge with respect to research are evidently seldom recognized in the wider society. They are rarely approached by policymakers, administrators in any sector outside the academic world for any professional or technological advice, for conducting specific studies or research that concern the people and country. We are not in a position at this juncture to discuss the reasons why external organizations rarely take the initiative in recognizing or inviting the services of these academics since our study does not take us into that domain.

Our analysis on the limited use of the talents of these scientists by nearly all sectors outside the universities for conducting research can be discussed only from the academic perspectives. First, of significance is the fact that the university system in Malaysia, because of its heritage, continues to be structurally rigid and traditionally patterned in some ways. Current university policies are focused largely on teaching. Universities have not assumed an important function in the growing professionalization of occupational life, and in introducing research and development as an aspect of business, industry, administration and the institutional life of society. None of the universities studied have established any kind of independent research centers or institutes that focus their activities primarily on research. Under these circumstances, the university system in Malaysia remains an influential system of higher education and its scientists engage in modest research activities organized primarily for achieving delimited scholarly goals and purposes. Given the confines of this situation, it will not yet become an effective system of research in the country. Second, there is a lack of any formal linkage systems between the academic institutions, the government, the government-sponsored research institutes, business, and local private industry. The few existing networks are loose in structure, created and maintained mainly by ad hoc individual efforts of individual scientists and their counterparts. The general underdevelopment of linkage systems has slowed down the establishment of viable communication, collaboration and mutual confidence between the academics and those outside the academic institutions inside the country. It has also slowed down the creating of shared understanding and inhibited selecting problems, technical and financial support for research, and in the transmission of research findings to prospective end users.

Table 14 gives the distribution of the sources of foreign funding for the 32 research projects of Malaysian scientists. Of the 32 research projects, 14 are funded by different international organizations, 2 are by a regional group (ASEAN), 6 are by foreign private foundations, and 10 are by foreign governments. The priorities of these foreign sources of funding are more heavily inclined toward applied rather than basic studies. Our sample reports that of the total 32 projects in which they are engaged, only 9 are on "basic" problems, 21 are on "applied" and 2 are a mixture of both. The process of allocation of fundings by the respective foreign sources are influenced by a combination of

TABLE 14.--Foreign Sources of Funding of Research Projects of Scientists in the Last Three Years.

Source of Funding	Number of Research Projects
Total	32
International Organization	
UNESCO	3
WHO (World Health Organization)	4
IAEA (International Atomic Energy Agency)	3
ECAP (Economic Commission for Asia and Pacific)	2
IFS (International Foundation for Science, Sweden)	1
World Bank	1
Regional Organization	
ASEAN (Association of Southeast Asian Nations)	2
Foreign Private Foundation	
Ford Foundation (USA)	4
China Medical Board (USA)	1
Alexander von Homboldt Foundation (West Germany)	1
Foreign Country's Government	
Australia	1
Canada	4
Japan	2
United Kingdom	1
United States	2

motives--humanitarian, foreign-aid policies, developmental, which usually imply, for the foreigners, support for applied research.

Table 15 provides the distribution of foreign sources of funding for specific research projects of scientists by major area of science. Among those who receive support for their research work from foreign sources the dominant groups are social scientists (40.6 percent) and life scientists, particularly those in general

TABLE 15.--Distribution of Foreign Sources of Funding for Specific Research Projects of Scientists by Major Area of Science.

Foreign Sources of Funding	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agr.		Life-Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total number of projects	32	100.0	2	6.2	2	6.2	8	25.0	1	3.1	6	18.8	13	40.6
International organization	14	100.0	1	7.1	1	7.1	5	35.7	0	0.0	2	14.3	5	35.7
Regional organization	2	100.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	1	50.0
Private foundation	6	100.0	1	16.7	0	0.0	1	16.7	0	0.0	0	0.0	4	66.6
Foreign government	10	100.0	0	0.0	1	10.0	1	10.0	1	10.0	4	40.0	3	30.0

life sciences (25 percent), and medical sciences (18.8 percent). Much of the research work carried out in these three areas consists of projects which include studies on the status of Malaysian economics in the '70s, public finance and enterprises in Malaysia, family planning and population control, bureaucracy and public administration, resettlement of communities in flood-prone areas, and vector and malaria control. In some, these externally funded studies have major implications for the building of science and for the larger society in Malaysia. In others, the studies merely take the form of "information gathering" to accommodate the needs of some foreign governments, groups or organizations that have a stake and specific interests in the country. Thus, as far as foreign sources of support for Malaysian scientists is concerned, greater awareness and interest are manifested in the social and life sciences, except agriculture, than in the physical and engineering sciences.

These sources which come from different international organizations, private foundations and some advanced countries of the world provide opportunities for Malaysian scientists to open up fields of research which otherwise would not be accomplished. They also help the scientists to build their transnational linkages with scientists, groups, and organizations around the world. These linkages contribute to the professional reputation of Malaysian scientists and bring recognition for their work within international scientific circles. More importantly, they create new patterns of relationships for the exchange of knowledge. The transnational networks of these scientists will be discussed in depth in Chapter V.

Accessibility to Facilities for Research

We now focus our analysis on scientists' accessibility to facilities for research. It is axiomatic that the success or failure of any research work done by most scientists directly relate to the availability of facilities for research. These include the physical dimension: adequate library facilities--textbooks, journals, bulletins and technical reports--space and laboratory equipment, animals, specimens, transportation and research funding. The personnel dimension includes technical supporting staff, colleagues for collaborative research and for sharing of ideas and information, and superiors who are supportive of individuals' research work. Scientists were asked whether they have adequate access to the aforementioned facilities for the conduct of their research activities. In response, nine out of ten indicate that they do have a fairly adequate supply of foreign books, journals, bulletins, documents, technical reports, etc., in their respective field of specialization but report a scarcity of vernacular books, documents and local professional journals as sources of information both for research purposes and for their teaching about research. In support of their statements, Table 16 gives the distribution of the different types of domestic and foreign journals found in both the primate and the newer universities' libraries in the country which were covered by this study.

TABLE 16.--Distribution of the Different Types of Domestic and Foreign Journals and Bulletins Located in Malaysian University Libraries by Major Area of Science.

Major Area of Science	Number of Journals and Bulletins					
	Total		Domestic		Foreign	
	N	%	N	%	N	%
Total	6,553	100.0	36	0.6	6,517	99.4
Physical	939	100.0	1	0.1	938	99.9
Engineering	802	100.0	6	0.7	796	99.3
Life-Gen.	612	100.0	3[a]	0.5	609	99.5
Life-Agr.	590	100.0	10	1.7	580	98.3
Life-Med.	2,080	100.0	2	0.1	2,084	99.9
Soc. Sci.	1,524	100.0	14	0.9	1,510	99.1

[a]This includes two journals, The Malaysian Journal of Science published by the University of Malaya, and Science Malaysiana published by the National University of Malaysia. These two journals not only cater to scientists in life-general but also those in natural sciences. They are included here as a matter of convenience.

The above data reveal that 99.4 percent of the journals in all scientific disciplines located in the Malaysian universities are imported from abroad. Only 36 (0.6 percent) of the journals are domestic in origin. Of these, a high proportion are in social and agricultural life sciences. Therefore, since both books and journals are mainly imported from abroad, this gives us one measure of the magnitude of the status of "dependency" of Malaysian scientists upon foreign sources as media of references in their scientific work. Since most Malaysian scientists have a reading knowledge of English, obviously they will have little difficulty in consulting much of the world literature on scientific subjects.

There are a number of reasons that contribute to the lack of locally published academic journals in the country. First, with the exception of the primate university, the publishing units in the newer universities are in the take-off stage. Therefore, publishing the academic achievements of scholars in Malaysian journals, monographs and mimeograph form is just beginning to develop. Second, the members of the scientific community outside academic institutions are generally less active readers of academic scientific works. Consequently, the demand for scientific journals in the larger society is not yet extensive. On the contrary, the readers of academic journals are largely confined to the academic scientific community. Third, most of the scientific societies in the country are newly established and therefore have yet to publish learned journals.

Having seen that scientists are not lacking in library facilities, particularly foreign books, journals, bulletins and so forth, we now proceed to examine the physical and social dimensions of the facilities available to scientists for research.

Physical Dimension

The presence of adequate physical facilities--laboratory equipment, specimens, animals--and financial resources are important both as tangible and symbolic resources. Altogether they make for enthusiasm, dedication and feeling of involvement in work among scientists as well as making possible the work itself. We asked scientists about how important each of these tangible objects was, and the extent to which each is available to them. Table 17 lists their responses to our question.

Approximately eight out of ten scientists consider equipment, specimens and other laboratory materials important in their work. The 21 percent who do not think so are social scientists in most instances. Equipment, specimens and other facilities along with books and journals are largely imported. Of those who consider them important, three-fourths indicate that they are available, while one-fourth do not feel they have adequate supplies of equipment, specimens and other physical facilities in their research work.

Those who do not have the necessary equipment, specimens and other materials to conduct their research are mainly engineering scientists and, to a lesser extent, general life scientists. Our interviews with some engineers reveal the reasons why they have some difficulties with equipment, such as machinery and apparatus. The most common response is that whatever the quality of equipment, machinery and apparatus they now have, they are consistently rated as less sophisticated and less adequate than they need for engaging in the kinds of projects they want. As one electrical engineer aptly summarized:

> In my own field we do have bits and pieces of equipment, machinery and apparatus. To me, these are moderately adequate to cater to the needs of small groups of undergraduates but certainly less adequate for graduate students. With the present available equipment it is not possible for me to work on major research in "system control."

TABLE 17.--Distribution of Availability of Equipment, Specimens and Other Laboratory Facilities for Research by Major Area of Science.

Major Area of Science	Total Sample		Availability of Equipment and Other Laboratory Facilities: Not Important		Important Available		Important Unavailable	
	N	%	N	%	N	%	N	%
Total	80	100.0	17	21.2	49	61.3	14	17.5
Physical	12	100.0	2	16.7	9	75.0	1	8.3
Engineering	13	100.0	1	7.7	5	38.5	7	53.8
Life-Gen.	14	100.0	0	0.0	10	71.4	4	28.6
Life-Agr.	13	100.0	1	7.7	11	84.6	1	7.7
Life-Med.	13	100.0	2	16.7	10	76.9	1	7.7
Soc. Sci.	15	100.0	11	73.3	4	26.7	0	0.0

Others in the life-general sciences recall the frustrations of having to wait for a long time, between six months to a year and sometimes more, for the arrival of equipment or specimens and other materials ordered from abroad. They reflect that these upsetting delays almost without exception have diminished their inner enthusiasm and lessened their capacity to fulfill projected research targets as well as affected their further work timetables. For example, consider two cases in which researchers have to postpone their projects because of the late arrival of specimens and equipment needed for their experiments. First is the case of a life scientist working on a project on poisoning. To proceed with the experiment he needs to use specimens which have to be ordered from abroad. It took approximately one year for the specimens to arrive. Second is also a life scientist working on "vector and malaria control" who, on a number of occasions, has had to wait between six months to one year for the arrival of equipment needed for her research. In both cases, the research projects have been delayed significantly.

In addition to equipment, specimens and other laboratory facilities, we also asked scientists about the importance of and the availability of research funds to them. As given in Table 18, we find that two-thirds (67.5 percent) deem it important and have adequate funding for research.

However, the relative lack of available funding for almost two-thirds of the engineers can be explained by several factors. Foremost is the fact that, as a group, they are solely dependent on funding from their own institution. In the primate university, priorities for allocation of research funding are always given to faculty members who are working on research projects which can provide them data for writing theses for advanced degrees. Therefore, scientists who are no longer involved in working for advanced degrees, which is true of many engineers, get low priorities for funding of research studies.

In the newer universities, priorities are given to developing curricula and the physical facilities of the institutions (training of staff, building and supplying of equipment, apparatus and specimens to the laboratories) rather than to the conduct of

TABLE 18.--Distribution of Availability of Funding for Research by Major Area of Science.

Major Area of Science	Total Sample		Availability of Funding: Not Important		Important Available		Important Unavailable	
	N	%	N	%	N	%	N	%
Total	80	100.0	2	2.5	54	67.5	24	30.0
Physical	12	100.0	1	8.3	9	75.0	2	16.7
Engineering	13	100.0	0	0.0	5	38.5	8	61.5
Life-Gen.	14	100.0	0	0.0	10	71.4	4	28.6
Life-Agr.	13	100.0	0	0.0	11	84.6	2	15.4
Life-Med.	13	100.0	0	0.0	10	76.9	3	23.1
Soc. Sci.	15	100.0	1	6.7	9	60.0	5	33.3

research. Thus, engineers in the primate and newer universities have fewer opportunities for securing research funding from their own institutions as well as from external sources.

Social Dimension

The availability and importance of technical supporting staff, colleagues for collaboration, and superiors who are supportive of their work are presented in Tables 19, 20 and 21. In the case of technical supporting staff, as shown in Table 19, eight out of ten in the sample (82.5 percent) regard them as important for their work and 60 percent of these say they are satisfactorily available. This is especially true of scientists in life-medical, life-general and engineering. Not as many social scientists feel

TABLE 19.--Distribution of Availability of Technical Supporting Staff for Research by Major Area of Science.

Major Area of Science	Total Sample		Availability of Technical Supporting Staff: Not Important		Important Available		Important Unavailable	
	N	%	N	%	N	%	N	%
Total	80	100.0	14	17.5	40	50.0	26	32.5
Physical	12	100.0	4	33.3	3	25.0	5	41.7
Engineering	13	100.0	1	7.7	7	53.8	5	38.5
Life-Gen.	14	100.0	2	14.3	8	57.1	4	28.6
Life-Agr.	13	100.0	0	0.0	8	61.5	5	38.5
Life-Med.	13	100.0	0	0.0	9	69.2	4	30.8
Soc. Sci.	15	100.0	7	46.7	5	33.3	3	20.0

the need for technical supporting staff but for those who do, almost two-thirds have it available. Roughly two-thirds of the physical scientists for whom it is important indicate the lack of available technical supporting staff such as laboratory assistants to support their activities. The physical sciences are newly developed fields in the country, and, therefore, experience difficulties in recruiting as well as training the technical assistants they require. A majority of the social scientists (80 percent) either do not consider technical supporting staff important in their work or, if they do, have it available.

Another important dimension in the conduct of research is the degree to which scientists have the opportunity to interact or collaborate with one another in order to stimulate and contribute to each other's effectiveness. The sample was asked to specify how important are colleagues for collaborative research and to state whether or not they are available. Table 20 gives the distribution of available colleagues for collaborative research.

Overall, eight out of ten scientists (86.3 percent) agree that colleagues are useful for their research work. Of these, six out of eight claim the presence of colleagues with whom they can interact meaningfully about their work and associate professionally. Those who note the absence of counterparts with whom they can relate and for whom it is important are primarily physical

TABLE 20.--Distribution of Availability of Colleagues for Collaborative Research by Major Area of Science.

Major Area of Science	Total Sample		Availability of Colleagues for Collaborative Research: Not Important		Important Available		Important Unavailable	
	N	%	N	%	N	%	N	%
Total	80	100.0	11	13.7	50	62.5	19	23.8
Physical	12	100.0	2	16.7	6	50.0	4	33.3
Engineering	13	100.0	2	15.4	5	38.5	6	46.2
Life-Gen.	14	100.0	2	14.3	8	57.1	4	28.6
Life-Agr.	13	100.0	1	7.7	10	76.9	2	15.4
Life-Med.	13	100.0	1	7.7	9	69.2	3	23.1
Soc. Sci.	15	100.0	3	20.0	12	80.0	0	0.0

scientists although a high proportion of others also report this. One possible explanation is that many Malaysian scientists are "one of a kind" in their own field of specialization and, therefore, have practically no opportunities to interact and relate to other scientists with common interests in their institutions or even in the country. Consider a case of one biological scientists who observes:

> I am the only person in my own field in this department and perhaps in the whole country. I work alone, and sometimes with the help of students who take my course. I have no one to talk to and to collaborate with. The only colleagues whom I know and communicate with, to discuss my research problems,are some scientists in the United States. As a matter of fact, two years ago I spent my sabbatical leave with them to work on some projects.

Many remark on the value of teamwork, informal contacts between fellow scientists and cross-disciplinary communications and cooperation for enlarging the range and output of their efforts. For some who are in disciplines which are well established in the universities, such as the life sciences (life-general, life-agriculture and life-medical) and social sciences, there are more abundant opportunities for interaction or collaborations. But a majority in the physical sciences and engineering maintain emphatically that there are great needs to increase the training of present staff in their own field and to expand the numbers in their field in order to have colleagues with whom they can talk over the content of their research before they can embark on new team research.

The output of research work is also affected by the availability of superiors who are supportive of the individual's research projects. Table 21 provides the collective responses to the

TABLE 21.--Distribution of Availability of Supportive of Scientists' Research Work.

Major Area of Science	Total Sample		Availability of Supportive Superiors					
			Not Important		Important Available		Important Unavailable	
	N	%	N	%	N	%	N	%
Total	80	100.0	21	26.3	42	52.5	17	21.2
Physical	12	100.0	6	50.0	2	16.7	4	33.3
Engineering	13	100.0	4	30.8	5	38.5	4	30.8
Life-Gen.	14	100.0	5	35.7	7	50.0	2	14.3
Life-Agr.	13	100.0	2	15.4	10	76.9	1	7.7
Life-Med.	13	100.0	1	7.7	7	53.8	5	38.5
Soc. Sci.	15	100.0	3	20.0	11	73.3	1	6.7

question relating to the importance and availability of support from the superiors in their department and/or institution. They indicate three distinctive patterns of responses. First, a little over half (52.5 percent) are affirmative about having superiors who are constantly supportive of their research activities. Second, 21.2 percent indicate that they do not have the support of their superiors in their research work. These are primarily in life-medical, physical sciences and engineering. Third, 26.3 percent do not consider superiors who are supportive of their research work as important.

There are three major complaints raised by scientists who do not have supportive superiors in their research. First, is the lack of sense of urgency among superiors to vigorously support their research work, particularly with regard to the purchase of equipment, apparatus and specimens as well as securing funds needed by them to conduct their research. Secondly, in some cases the presence of passive leadership and excessive bureaucratic atmosphere maintained by superiors in their units oftentimes make them feel frustrated in their personal relationships with superiors and in coping with the general work pattern of the units. Thirdly, the selection of young inexperienced scientists as heads of departments and deans of faculties often results in failure to provide them with freedom and encouragement to build and develop their research.

In sum, though, our sample of scientists, with the exception of some in physical sciences and engineering, do have both the physical and social facilities needed to conduct their research work.

Scientists' Research Projects:[13] A Micro Perspective

Having described selective aspects influencing scientists' involvement in research, we now proceed to consider discussing scientists' performance in specific research projects and the degree to which these projects are performed as individual efforts or in collaboration with other scientists.

---

[13]Projects hereby referred to as planned research work include all types of studies--theoretical, methodological, experimental, technological, adaptive, clinical, applied and taxonomic.

Distribution of Research Projects

We asked each person to indicate the number of research projects in which they have been involved since the beginning of their scientific career. Thus clearly many scientists have been involved in some forms of research even though there is general agreement among them that overall scientific research in the country is not as satisfactory in terms of quantity and quality of output as it should be. Of interest are some comparative analyses of scientists' involvement in specific research projects by major area of science, by ethnic groups and by generations. Table 22 shows the distribution of research projects of scientists.

The table shows that the highest number per person of research projects have been done by scientists in life-medical (11.85), and life-general (10.21). Moderate performance is

TABLE 22.--Distribution of Number and Average Number of Research Projects of Scientists by Major Area of Science.

Major Area of Science	Number of Scientists	Number of Research Projects	Average Number per Scientist
Total	80	602	7.52
Physical	12	93	7.75
Engineering	13	66	5.08
Life-Gen.	14	143	10.21
Life-Agr.	13	38	2.92
Life-Med.	13	154	11.85
Soc. Sci.	15	108	7.20

characteristic of scientists in the physical sciences (7.75), social sciences (7.20) and engineering (5.08). Life-agricultural scientists are the lowest with 2.92 projects per person.

The high average number of medical and life-general sciences can be attributed to the facts that: (1) Most of them belong to the senior generation, the majority of whom have received their first degree training either before the country's independence or immediately after independence between 1957-1961. Compared to other scientific groups in the country, they have a long tradition of being involved in research activities. (2) Less than a third (30.7 percent of the medical scientists and only 7.1 percent of scientists in life-general are involved in administrative duties compared to 46.2 percent, agricultural scientists; 50 percent, physical scientists; 53.8 percent, engineering scientists; and 60 percent, social scientists. (3) The medical scientists are among the groups who have frequent opportunities to obtain research fundings not only from their own institution but also from external sources, particularly foreign. These factors together help to reinforce their own enthusiasm and motivation to engage in extensive research as the data show. A similar trend is also prevalent among scientists in life-general sciences. Like the medical scientists, some of them are also senior scientists who have had extensive research careers. Consider the case of one female scientist in life-general who has been involved in 38 research projects since 1957.

The moderate incidence of performance in research among scientists in physical sciencies, social sciences, and engineering can be related to the high percentage of them in administration. In addition, they, too, receive less funding from external sources for their research projects, thereby restricting the scope of their research activities.

In life-agriculture, the low rate of scientists in research projects is attributable to the fact that most of them are young scientists just starting their scientific careers in the newly established University of Agriculture. Therefore, their recent entry into the field helps explain the lower number of research projects performed by them.

Ethnic differences in terms of participation in specific research projects is shown in Table 23. The assembled data in Table 23 shows that out of the total 602 research projects carried out, 121 (20.1 percent) were conducted by Malays, 292 (48.6 percent) by Chinese and 189 (31.3 percent) by Indians. On the basis of average number of projects per ethnic scientist, the Indians rank highest

TABLE 23.--Distribution of Research Projects of Scientists by Ethnicity.

Major Area of Science	Number of Scientists	Number of Research Projects	Average Number per Scientist
Total	80	602	7.5
Malay	27	121	4.5
Chinese	36	292	8.1
Indian	17	189	11.1

with 11.1 per scientist, the Chinese second with an average of 8.1 percent per scientist, and the Malays lowest with 4.5 per person.

To some extent, the pattern illustrates the differential participation of the ethnic groups in fields of science: the Chinese are oriented more toward physical sciences and engineering, the Indians toward life-medical and the Malays toward social sciences, and hence reflect relative funding patterns. The Malays are lowest for several reasons: (1) Their involvement in administration is highest. Presently, the trend is for the upper level university authorities to appoint Malays to important academic administrative positions, such as chairman of department and dean of faculties. This is to help in planning and in carrying out the transition from English to Bahasa Malaysia as the medium of academic instruction (except for the National University of Malaysia where the medium is already in Bahasa Malaysia) in all universities, which will be fully implemented by 1982. Hence the Chinese' increasingly limited participation in administrative duties provides them with more ample and growing opportunities to concentrate more of their time and effort on research. (2) In all scientific disciplines more Chinese and Indians belong to the senior generations than do the Malays who belong primarily to the younger generations of scientists. Thus the Chinese and Indians have been involved for a much longer period of time in scientific work than the Malays. In contrast, the Malays are just beginning their active participation in science and, as a consequence, they have lower productivity in number of research projects.

When the variable generation is considered, and comparisons are made between the four generations, the first generation averaged 15.62 research projects per scientist; the second generation, 14.00; the third generation, 6.53; and the fourth generation, 2.73. In terms of age, as a group most of the third generation are between 31 and 40 years, and the fourth generation are between 26 and 30 years. Most of them, therefore, are relatively young scholars. Thus even though they are consistently enthusiastic about doing research, in terms of research performance and productivity, they are less far along than those of the first and second generations who have been involved for many years in research.

Individual Vis-à-Vis Collaborative Research

In considering the research projects of scientists, we have asked them to indicate the extent to which they were principal researchers or co-researchers with other scientists in conducting their work. It is interesting to see in Table 24 that of the total 602 research projects, 387 (64.3 percent) are projects in which scientists worked alone and, in contrast, 215 (35.7 percent) are projects in which they worked with colleagues.

With nearly two-thirds of the projects being the product of scientists' individual efforts, it became evident that many of them do not usually collaborate with other scientists in their departments or elsewhere in the country. A high proportion of them are highly specialized in their research and "one of a kind" in their field which makes for interests that are removed from each other.

TABLE 24.--Distribution of Scientists' Research Projects in Six Clusters of Disciplines by Type of Investigator.

Major Area of Science	Total Sample		Type of Investigator: Sole Investigator		Type of Investigator: Co-Investigator	
	N	%	N	%	N	%
Total	602	100.0	387	64.3	215	35.7
Physical	93	100.0	47	50.5	46	49.5
Engineering	66	100.0	47	71.2	19	28.8
Life-Gen.	143	100.0	82	57.3	61	42.7
Life-Agr.	38	100.0	31	81.6	7	18.4
Life-Med.	154	100.0	84	54.5	70	45.5
Soc. Sci.	108	100.0	96	88.9	12	11.1

Consequently, they lack a cluster of scientists with whom they can interact, communicate and exchange ideas in respect to their research enterprises. Moreover, many of these scientists are developing new fields of specialization within their departments and institutions, and in the process of doing so they, too, develop new areas of research.

In contrast, for the overall one in three research projects which are collaborative efforts by scientists, they interact with colleagues and students in their research. The most predominant of these groups are individuals in physical sciences (49.5 percent), life-medical (45.9 percent) and life-general (42.7 percent). They usually assert that collaborative research has several advantages over individual research. By combining their efforts with other colleagues they have better opportunities for getting financial support from the university and other potential grant-giving bodies for their projects. They can make more rapid progress in the work to be done and by mutual stimulation avoid stagnation in research productivity. Their formal records show that they are the most productive researchers, as measured by publications. In contrast, the least involved in collaborative efforts are the social scientists, the agricultural scientists and the engineering scientists. They do not share common interests, and most of them are "one of a kind" in their fields. With dissimilar paradigmatic interests and no common interest in any societally defined problem, they find it difficult to have colleagues as co-workers in their research work.

Research Publication

One common measure of productivity is total number of publications of a scientist. Scientific productivity as defined here does not comprise any evaluation of the recognition or uses of various scientific findings. Instead it refers only to two gross quantities: the number of publications and the number of people making such publications. This section concerns the specific research productivity of our sample of scientists.

Incidence of Productivity

Each person was asked the number of research articles published both as single authors and as co-authors. The patterning of responses suggests a tendency to round off productivity in multiples of five and this tendency has been adopted as shown in the distribution of publications in Table 25.

TABLE 25.--Distribution of Publication of Research Reports of Scientists.

No. of Publications	No. of Respondents	%
Total	80	100.0
1-5	41	51.3
6-10	22	27.5
11 and more	17	21.2

The data show that many produce a few and a few produce many articles. Seven out of ten persons in the sample (78.8 percent) have published ten or less research articles whereas 21.2 percent have published 11 or more research articles. These results are not entirely unexpected, for studies elsewhere have shown that publications for a given group typically follows Lotka's "law of distribution": that five percent of the scientists produces half of the literature in a field, while another half produces only five percent (D. de Solo Price, 1963: 40-50).

Differences occur among the six major areas of science, in the three ethnic groups, in the four generations and in the degree of scientists' collaboration with counterparts in publishing their research reports both domestically and abroad. The productivity of research reports among scientists in the six clusters of scientific disciplines is shown in Table 26.

TABLE 26.--Distribution of Research Publications of Scientists by Major Area of Science.

Major Area of Science	Total Sample		Number of Research Publications					
			1-5		6-10		11 +	
	N	%	N	%	N	%	N	%
Total	80	100.0	41	51.3	22	27.5	17	10.0
Physical	12	100.0	5	41.7	3	25.0	4	33.3
Engineering	13	100.0	11	84.6	1	7.7	1	7.7
Life-Gen.	14	100.0	7	50.0	1	7.1	6	42.8
Life-Agr.	13	100.0	9	69.2	4	30.8	0	0.0
Life-Med.	13	100.0	3	23.1	6	46.1	4	30.8
Soc. Sci.	15	100.0	6	40.0	7	46.6	2	6.7

Among persons who have published 11 or more articles, the most productive are in life-general, followed by physical sciences and medical sciences. Of those who have 10 or less publications, the most predominant are the agriculturally related scientists (100 percent), engineering (92.3 percent) and social scientists (86.7 percent). The higher rates of production prevalent among the former three groups versus the latter three correlate, in part, with the previously noted contrast between the two groupings in extent of being actively involved in research work.

Table 27 contains the differences in publication rates among the three ethnic groups.

The output of the ethnic groups is highly skewed; within each ethnic group many produce few papers and a few produce many.

TABLE 27.--Distribution of Research Publications of Scientists by Ethnicity.

Ethnicity	Total Sample		Number of Research Publications					
			1-5		6-10		11 +	
	N	%	N	%	N	%	N	%
Total	80	100.0	17	21.2	28	35.0	35	43.8
Malay	27	100.0	12	44.4	7	25.9	8	29.6
Chinese	36	100.0	4	11.1	17	47.2	15	41.7
Indian	17	100.0	1	5.9	4	23.5	12	70.6

Nonetheless, the trend clearly shows that generally the Chinese and Indians are more productive in terms of publishing their research than the Malays. At this juncture, it is impossible to reconstruct all the antecedent conditions which might influence the interaction between a scientist's performance, and the individual's ethnicity, but several conditions of known importance can be identified. These include: (a) Length of working experience. As a group the Chinese and Indians have substantially longer working experience in professional activities in the country than the Malays. This has provided them with greater cumulative opportunities to participate in research and to produce more research than the relative newcomers and inexperienced Malay scientists. (b) Involvement in administration. Again, as a group the Chinese and Indians are predominantly less preoccupied with administration than their counterparts, the Malays, thus giving them substantial amount of time available to them to participate in research and to publish its results.

(c) The speed with which scientists complete their formal training. A majority of the Chinese and the Indians receive their bachelor, masters, and doctorate degrees much earlier in their career history than the majority of Malays, thereby enabling them to enter the years of productive work ahead of the Malays. There are undoubtedly many other factors which account for the relationships between performance and the antecedent conditions examined. However, it is not our purpose to identify the entire chain of causality. Table 28 discusses the differences in rates of publication among the four generations. Most productive are scientists in the first and second generations. They are followed by the third generation. The least productive is the fourth generation.

Lehman's study (1953) shows that pioneering discoveries in various scientific fields are most likely to occur among those in

TABLE 28.--Distribution of Research Publications of Scientists by Generation.

Generation	Total Sample		Number of Research Publications					
			1-5		6-10		11 +	
	N	%	N	%	N	%	N	%
Total	80	100.0	17	21.2	28	35.0	35	43.8
First	8	100.0	0	0.0	2	25.0	6	75.0
Second	14	100.0	2	14.3	3	21.4	9	64.3
Third	47	100.0	8	17.0	20	42.6	19	40.4
Fourth	11	100.0	7	63.6	3	27.3	1	9.1

the late 30s or early 40s age grades and thereafter there is a steady decline in frequency. In examining our data, we find one peak of scientific performance, as reflected in number of publications, in roughly the same points in their life cycle. For our purposes most of these scientists belong to the first and second generations and also some members of the third generation. A search for factors that might account for their high output indicates that as individuals they are motivated toward establishing their own professional reputation as scientists, not only for their self-satisfaction but also for the purposes of achieving recognition from the scientific community, policymakers and the larger public. Some of them who are less involved in administration and committee work have more time for research work and thereby for productive scientific ouput. The fourth generation, as we encounter them, have, as yet, modest publication records. They are young, inexperienced, and are in the early stage of building their research careers. When we consider whether scientists have published as co-authors with other Malaysian scholars or alone, Table 29 shows that one out of two in our sample (50 percent) have collaborated with Malaysians in publishing some of their research reports. Collaboration is most common in life-general and life-medical, followed by physical and agricultural sciences.

As for Malaysian scientists collaborating with foreigners in publishing their findings, Table 30 (page 130) reveals that a somewhat larger proportion (55 percent) have done so than in collaborating with Malaysian associates. Divided by the identity of

TABLE 29.--Distribution of Incidence of Scientists' Co-Authorships in the Publication of Research Manuscripts with Malaysian Counterparts by Major Area of Science.

Major Area of Science	Total Sample		Incidence of Co-Authorships with Malaysian Counterparts			
			Yes		No	
	N	%	N	%	N	%
Total	80	100.0	40	50.0	40	50.0
Physical	12	100.0	7	58.3	5	41.7
Engineering	13	100.0	4	30.8	9	69.2
Life-Gen.	14	100.0	9	64.3	5	35.7
Life-Agr.	13	100.0	6	46.2	7	53.7
Life-Med.	13	100.0	9	69.2	4	30.8
Soc. Sci.	15	100.0	5	33.3	10	66.7

the foreigners, data indicate a strong tendency for Malaysian scholars to interact and collaborate with British scholars (25 percent) in publishing their research. This is followed by joint publications with Americans (12.5 percent), Australians (6.2 percent), Canadians (5 percent), Southeast Asians (3.7 percent), and Asians excluding Southeast Asians (2.5 percent). Such practice of associating with some foreign scientists perhaps provides Malaysian scientists with better opportunities for their articles to be accepted for publication in some relatively central (core) scientific journals abroad. But more importantly, it reveals the extent of the scientists' participation in information exchange as well as a web of

TABLE 30.--Distribution of Incidence of Scientists' Co-Authorships in the Publication of Research Manuscripts with Foreigners by Major Area of Science.

Major Area of Science	Total Sample		Incidence of Co-Authorship with Foreigners													
			None		British		Ameri-cans		Aus-tralians		Canadians		S.E. Asians		Asians (exc. S.E. Asia	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	36	45.0	20	25.0	10	12.5	5	6.2	4	5.0	3	3.7	2	2.5
Physical	12	100.0	2	16.7	5	41.7	1	8.3	1	8.3	2	16.7	1	8.3	0	0.0
Engineering	13	100.0	9	69.2	4	30.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Life-Gen.	14	100.0	2	14.3	6	42.9	1	7.1	1	7.1	2	14.3	2	14.3	0	0.0
Life-Agr.	13	100.0	4	30.8	2	15.4	3	23.1	3	23.1	0	0.0	0	0.0	1	7.7
Life-Med.	13	100.0	6	46.1	3	23.1	4	30.8	0	0.0	0	0.0	0	0.0	0	0.0
Soc. Sci.	15	100.0	13	86.6	0	0.0	1	6.7	0	0.0	0	0.0	0	0.0	1	6.7

informal networks with foreign scientists. However, the pattern of co-authorships with foreigners in the six scientific disciplines varies. Individuals in the physical sciences, life-general and life-agriculture sciences maintain a more global pattern of collaborative authorships with foreign scientists. They establish co-authorships with British, American, Australian, and to a lesser extent with Asian and Canadian scientists. Medical scientists collaborate more with American and British scientists than others. Engineers collaborate only with British scientists. Social scientists are the least involved in publishing their research manuscipts with foreign scentists; only two have collaborated with foreigners (one with an American and the other with a Japanese).

In sum, what is important is the fact that co-authorships clearly illustrate the amount of participation of Malaysian scientists in establishing professional linkages with foreign scientists in their scientific enterprises.

Research Publication Outlets: Domestic and Foreign

Malaysian scientists publish their research both in domestic and foreign scientific journals. Seventy-seven percent publish all their scientific research results within the country compared to 23 percent who publish none in the country. Table 31 offers the variations of publication outlets located in different areas of the world. The pattern indicates that four out of ten or better Malaysian scientists (except social scientists and life-agriculture) are strongly inclined toward publishing their research in the

TABLE 31.--Distribution of Publication Outlets of Scientists in Different Areas of the World by Major Area of Science.

Major Area of Science	Total Sample		Foreign Publication Outlets													
			United Kingdom		United States		Austr.		Canada		Europe		S.E. Asia		Asia (exc. S.E. Asia)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	35	43.8	24	30.0	20	25.0	6	7.5	22	27.5	22	27.5	9	11.3
Physical	12	100.0	7	58.3	4	33.3	3	25.0	2	16.7	4	33.3	3	25.0	1	8.3
Engineering	13	100.0	7	53.8	4	30.8	2	15.4	0	0.0	1	7.7	1	7.7	0	0.0
Life-Gen.	14	100.0	9	64.3	4	28.6	3	21.4	1	7.1	6	42.9	5	35.7	1	7.1
Life-Agr.	13	100.0	2	15.4	1	7.7	3	23.1	1	7.7	2	15.4	1	7.7	3	23.1
Life-Med.	13	100.0	10	76.9	3	23.1	7	53.8	2	15.4	4	30.8	7	53.8	1	7.7
Soc. Sci.	15	100.0	0	0.0	8	53.3	2	13.3	0	0.0	5	33.3	5	33.3	3	20.0

[a]Does not add to 100.0 percent because some scientists published in more than one area.

United Kingdom (43.8 percent). England has long been envisioned as the center of scientific knowledge as well as being the center of foreign education among many generations of Malaysian students, including most of our sample in this study. This long historical relationship growing out of the Colonial past has given them ample opportunities to establish personal ties with British scholars and to become familiar with scientific journals that are published in the United Kingdom. Others in the sample mainly publish their research results in scientific journals which are located in other parts of the world. Given the fact that many of the research accomplishments of these scientists have been published in different parts of the world suggests that Malaysian scholars are not merely consumers of knowledge produced by other members of the international scientific community, but also in a moderate way they are producers of a body of knowledge that could be shared regardless of nationality and country. At the same time they have established a web of connections with other scientists around the world.

When comparisons are made between the six scientific disciplines in publication of research abroad, the highest proportion occurs among medical scientists. Their research reports appear most widely in scientific journals around the world. They are on both accounts followed by the general life and physical scientists. The engineers published much of their foreign research in the United Kingdom and to a lesser degree in the United States and Canada. In life-agriculture, much of their foreign published research is in Asian journals and less in other areas of the world. For the social sciences foreign publishing is done most frequently in the United States and Asia and to a lesser extent in Europe and minimally in Australia. None have published their research in the United Kingdom.

If these trends serve as any measure of scientific contribution to world knowledge, then evidently some Malaysian scientists do disseminate their scientific results to the world's scientific community.

The Scientists' Domestic and Foreign Publications and the Citation of These Publications

Having discussed scientists' domestic and foreign publications and their incidence of co-authorships with Malaysian and foreign scholars, we now proceed to analyze the citation of these publications. We recognize that one of the factors influencing place of publication is the recognition of one's work by members of the international scientific community. Using the Science Citation Index for a five-year period, 1972-76, we found that 38.8 percent of the Malaysian scientific community sample had one or more citations to their publications. Table 32 provides the distribution of scientists by where they published and whether at least one citation of one article published in that place was noted in the Science Citation Index.

Overall, one out of eight persons (12.9 percent) had one or more citations of their Malaysian-published articles. Among Malaysian-published articles cited, the most dominant were in the field of medicine, in which two out of five persons (46.2 percent) had at least one citation. Of our sample's foreign-published

TABLE 32.--Distribution of Malaysian Scientific Community Sample by Where They Published and Whether at Least One Citation of One Article in That Place Was Noted in the Science Citation Index,[a] 1972-76

At Least One Publication in (at Least One Citation in) SCI	Number Publishing in Country	Number With at Least One Citation of Article Published	Percent With at Least One SCI Citation
Total	80	31	38.8
Malaysia	62	8	12.9
Great Britain	35	16	45.7
United States	22	17	77.3
Australia	20	8	40.0
Europe	22	5	22.7
Canada	6	2	33.3
Southeast Asia	22	3	13.6
Asia (excluding Southeast Asia)	9	2	22.2

[a]Science Citation Index, Institute for Scientific Information.

articles cited, the most frequent were in the fields of medical and general life sciences, in which six out of ten persons (61.5 and 64.3 percent, respectively) in each discipline had at least one citation. The physical sciences had one out of two scholars (50.7 percent) with at least one citation. The least cited were the engineering (30.8 percent) and the agriculturally related scientists (30.8 percent). Roughly speaking, if scholars in Malaysia published in Western journals, the likelihood was three times as great to have a citation, whereas if the publications were in Southeast Asian journals only one scholar in ten (13.6 percent) received a citation.

The preceding section can be briefly summarized as follows. Scientists' research activities and achievement are distributed in a markedly unequal fashion. Some, especially those in life-general and life-medical, are actively involved in research. In contrast, most scientists in other disciplines are surrounded by administrative demands that make it difficult for them to maintain the acting of their professional roles as working scientists dedicated to the pursuit of knowledge. Many in our sample feel that they received more than adequate funding for their research work but some report having inadequate facilities and receiving less than they need.

Having discussed the complex combination of factors surrounding the organization of the research activities of scientists, the following chapter will focus on the phenomenon of sharing and disseminating of scientific knowledge among scientists inside the country.

CHAPTER IV

SOCIAL EXCHANGE AND COMMUNICATION NETWORKS AMONG SCIENTISTS INSIDE THE COUNTRY

The previous chapter discussed the organization of the research activities of Malaysian scientists and the complex combination of factors affecting those activities. This chapter will focus on the networks established by university-based scientists in Malaysia for the purposes of creating, sharing and disseminating knowledge. Such patterns of communication networks and interpersonal professional relationships will be considered from the viewpoint of the scientists themselves and will include (1) the sharing of knowledge: a micro perspective; (2) the dissemination of knowledge: avenues for the transmission of research results; (3) the role of men and women of knowledge: scientists as consultants.

The Sharing of Knowledge: A Micro Perspective

It is generally assumed that in scientific undertakings, professional groupings influence scientists' research decisions and activities at crucial points. Some of these groupings are formal organizations such as professional and scientific associations, laboratory research groups and academic institutions. Others are collectivities which are designated as disciplines. Others are less formal but perhaps more important--e.g., limited groups of scientists who interact with one another about their particular research and fields of interest both within and without their own institution. These persons have established close ties, formed friendships, explored mutual intellectual concerns, reflected in their common experiences and often worked together on studies and programs within the broad range of an emerging scientific community. Our focus here is on the participation of our sample of Malaysian scientists in various types of social groupings. Included in the analysis are (a) the scientists' intra-institutional and extra-institutional communication networks; (b) the scientists' participation in scientific meetings inside the country; (c) the scientists' membership in local professional and scientific organizations.

Scientists' Institutional and Extra-Institutional Communication Networks

Scientific activity anywhere usually is a highly uncertain undertaking and regular scientific communication helps to reduce such uncertainty. Even higher uncertainty is endemic in the social structure of a relatively new scientific community in a developing country which lacks a long tradition of past accomplishments to sustain mutual confidence and is without a powerful set of leaders to serve as role models for and as effective support for oncoming generations. The reduction of these conventional and newer sources of uncertainty can be done by (1) keeping the individual scientists abreast of new developments. Current knowledge is essential for scientists who expect to do creative and useful work after their return from a foreign education; (2) assuring the scientists of a continuing sense of the changing trends in their own specialized field and of the relative importance of their current work; (3) redirecting and broadening the scientists' span of interest and attention in the context of the local situation; (4) obtaining critical response and eliciting support and recognition for work accomplished; (5) reaffirming a feeling of identity with a larger community of scientists who have common values. In order to participate in such scientific communication, there must be some individuals present who have comparable scholarly concerns and fields of specialization with whom the scientists can meaningfully communicate and ideally establish personalized relationships even on a limited scale.

Our findings show that the sample of Malaysian scientists communicate and establish personalized relationships differentially with counterparts in their own institution and selectively with their professional colleagues in Malaysia but outside their own institution. These professional colleagues include foreigners employed in their institutions as well as Malaysians.

First, we will examine the patterns and variations of personalized relationships created and maintained by scientists with their Malaysian counterparts. With regard to the actual availability of other individuals with similar fields of specialization within a discipline in a scientist's own institution, the findings in Table 33 provide the information classified by the major areas of science.

TABLE 33.--Distribution of Number of Colleagues With Comparable Professional Field in Own Institution by Major Area of Science.

Major Area of Science	Total Sample		Number of Colleagues in Own Institution			
			No One in Field Own Institution		Minimum of One Other Colleague	
	N	%	N	%	N	%
Total	80	100.0	18	22.5	62	77.5
Physical	12	100.0	4	33.3	8	66.7
Engineering	13	100.0	3	23.1	10	76.9
Life-Gen.	14	100.0	5	35.7	9	64.3
Life-Agr.	13	100.0	2	15.4	11	84.6
Life-Med.	13	100.0	2	15.4	11	84.6
Soc. Sci.	15	100.0	2	13.3	13	86.7

Table 33 indicates two modal patterns of distribution with respect to the presence of persons in the same university with a comparable professional field of specialization as the respondents. It shows that 22.5 percent are the only persons in their own professional field at a particular academic institution and hence can be described as being "one of a kind" in their professional field at their own university. Such a situation provides them little opportunity to have regular and close working relationships or continuing exchanges with other scientists in a similar field within their institution of affiliation. Higher proportions of them are found in the life-general and physical sciences than in the other disciplinary clusters.

In contrast, nearly four out of five (77.5 percent) mentioned the presence within their institution of other scientists whose fields of specialization are comparable with their own. Most work, therefore, in academic environments where there are other scientists with comparable fields of interest and with whom they could interact in conjunction with their specific research and primary scientific interest.

Having determined the availability of these other scientists with comparable professional fields of interest in the individual's own institution, we further explore the extent to which respondents do actually talk with and/or work regularly with their Malaysian counterparts in their institutions and the frequency of their encounters in their ordinary work relationships. Our findings show that of the total sample, almost two-thirds (63 percent) report that they do participate with colleagues in informal discussion sessions about their common work problems and exchange ideas with their counterparts in related or adjoining fields.

Table 34 contains the distribution of the number of persons with whom scientists often exchange information in their own institutions.

Our data show that of those who have a minimum of one other colleague, eight out of ten (80.6 percent) interact with at least one other person in their institutions. They believe that they do have continuing contact with at least one of them with whom they

TABLE 34.--Distribution of Number of Malaysian Colleagues in Own Institution with Whom Scientists Interact by Major Area of Science.

No. of Malaysian Colleagues with Whom Interact	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agr.		Life-Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Has a minimum of one other colleague	62	100.0	8	100.0	10	100.0	9	100.0	11	100.0	11	100.0	13	100.0
Interacts with at least one other colleague	50	80.6	7	87.5	3	30.0	9	100.0	9	81.8	10	90.9	12	92.3
Has colleague but does not interact	12	19.4	1	12.5	7	70.0	0	0.0	2	18.2	1	9.1	1	7.7

can exchange significant information about the contents of their work-related interests and openly discuss professional topics of mutual interest.

The patterns of their personalized relationships vary, although the modal pattern is to work closely with colleagues within their own department rather than with colleagues outside their own department but within their university. Of the total 50 scientists who interact with at least one other colleague, 3 (6 percent) have personalized relationships with their advanced graduate students, 40 (80 percent) have created and maintained working relationships with their departmental colleagues, and 7 (14 percent) have ties with counterparts from both their own departments and other departments in their institution. Thus, the pattern indicates a greater tendency for scientists to create and maintain personalized working relationships and to share their work problems with their own departmental colleagues than with either their students or other colleagues.

Of particular interest is the comparison among scientists in the six major areas of science in their personalized relationships with their Malaysian counterparts in their own department.

By scientific disciplines, the assembled data show that with the exception of the engineering scientists, most individuals in the other five disciplines are highly involved in personalized relationships with their counterparts. As far as the engineers are concerned, most of them do have someone else with whom to communicate, but they are less involved. One of the major reasons why they do not interact is because currently they are engaged in developing their own fields--building curriculum, recruitment of staff, etc., especially among those in the newer universities. They, therefore, have little opportunity for the present to pursue their research interest activity. Among those who communicate and maintain close social ties, they are found to work frequently together. Some extend their friendship by visiting each other's families. To substantiate our argument, Table 35 shows the distribution of the frequency of meetings between the sample and their local counterparts.

The findings reveal that slightly over half (56.5 percent) are regularly involved once or more a week in some form of informal

TABLE 35.--Distribution of Frequency of Meetings Among Scientists Who Interact With at Least One Other Colleague in Own Institution by Major Area of Science.

Major Area of Science	Total Sample		Frequency of Meeting: Once a Week or More		Occasionally		Do Not Interact	
	N	%	N	%	N	%	N	%
Total	62	100.0	35	56.5	15	24.2	12	19.3
Physical	8	100.0	4	50.0	3	37.5	1	12.5
Engineering	10	100.0	1	10.0	2	20.0	7	70.0
Life-Gen.	9	100.0	8	88.9	1	11.1	0	0.0
Life-Agr.	11	100.0	5	45.4	4	36.4	2	18.2
Life-Med.	11	100.0	9	81.8	1	11.1	1	9.1
Soc. Sci.	13	100.0	8	61.5	4	30.8	1	7.7

professional interaction with their colleagues in their institution, and 19.3 percent of the respondents are not involved in any form of interaction process with other scientists within their institution.

The general life scientists and the medically related scientists have greater frequency of meetings than other disciplines and, thereby, maintain personalized ties with their local counterparts. Eight out of ten scientists in both disciplines (88.9 percent of life-general, and 81.8 percent of life-medical) meet as often as once a week or more. They are followed by the social scientists (61.5 percent) and physical scientists (50 percent).

Interpersonal Ties With Foreign Scholars in Scientists' Own Institutions

The personalized relationships of our sample are not confined to only their Malaysian counterparts. They also encompass interacting with foreign scholars who are currently employed in their departments. Foreign scientists are no novelty in an ex-colonial country with extensive transactions in the emerging world systems and with elaborate ties with the nascent world-encompassing scientific community. The presence of foreign scholars in residence at this time creates little uneasiness in the indigenous scientific community, most of whom have had a foreign education. As yet there is no anti-foreign political ideology or movement among intellectuals, nor is there deference or sensitivity to foreign scientists as being part of the colonial heritage.

We asked our respondents to specify the number of foreign scholars who are employed in their own departments. A third

(35 percent) reported that there were foreign scientists present and we estimate that there were 102 foreign scholars employed in the departments which contain the six scientific areas. Three out of four foreign scholars (77.5 percent) are in the primate university and the rest (22.5 percent) are in the three newer universities.[14]

Table 36 shows the distribution of the country of origin of these foreign scholars by major area of science.

Thirty foreign scholars (29.4 percent) are from countries in South Asia; 24 (23.5 percent) are from Southeast Asian countries; 19 (18.6 percent) are from the United States; 18 (7.6 percent) are from the United Kingdom; 5 (4.9 percent) are from Australia and New Zealand; 3 (2.9 percent) are from Canada; and 2 (2 percent) are from Europe and one (1 percent) is from Taiwan. Clearly, the data indicate that over half of the foreign scholars originate from countries in South and Southeast Asia, another third comes from the United States and the United Kingdom. Further, these foreigners are largely concentrated in the physical sciences (30.3 percent), life-general (26.4 percent), social sciences (18.6 percent) and engineering (12.7 percent). They are not common in agricultural and medical sciences which had already reached a higher degree of growth and development in Malaysia before independence.

The presence of foreign scholars in their midst offers potential opportunities for Malaysian scientists and their foreign

---

[14]Forty-nine of these foreign scholars (48 percent) are employed on regular contract and have permanent tenure, 50 (49 percent) are on short-term contract and 3 (3 percent) are visitors.

TABLE 36.--Distribution by Country of Origin of Foreign Scholars by Major Area of Science.

Country of Origin	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agr.		Life-Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	102	100.0	31	100.0	13	100.0	27	100.0	5	100.0	7	100.0	19	100.0
United Kingdom	18	17.6	7	22.6	2	15.4	3	11.1	0	0.0	1	14.3	5	26.3
Australia and New Zealand	5	4.9	1	3.2	1	7.7	2	7.4	1	20.0	0	0.0	0	0.0
Canada	3	2.9	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0	2	10.5
United States	19	18.6	5	16.1	0	0.0	9	33.3	2	40.0	1	14.3	2	10.5
Europe	2	2.0	1	3.2	1	7.7	0	0.0	0	0.0	0	0.0	0	0.0
South Asia	30	29.4	9	29.0	6	46.1	7	25.9	1	20.0	2	28.6	5	26.3
Southeast Asia	24	23.5	8	25.8	2	15.4	6	22.2	0	0.0	3	42.8	5	26.3
Taiwan	1	1.0	0	0.0	1	7.7	0	0.0	0	0.0	0	0.0	0	0.0

counterparts to establish trans-societal personalized relationships either on a short- or long-term basis. Not all Malaysian scholars have the same opportunity to associate frequently with foreigners in their institution, in part because there are no available foreigners in their departments. Almost two-thirds of our sample (65 percent) note that they do not have foreigners positioned in their departments. Table 37 offers the distribution of foreign scholars in scientists' departments in six clusters of scientific discipline.

For the 28 (35 percent) who have foreigners in their departments, all cite having continuing interactions with at least one foreigner. By scientific disciplines, the most dominant to interact

TABLE 37.--Distribution of Foreign Scholars in Scientists' Department by Major Area of Science.

Major Area of Science	Total Sample		Foreign Scholars in Scientists' Department: No Foreign Scholar		Foreign Scholars in Scientists' Department: Has at Least One Foreign Scholar	
	N	%	N	%	N	%
Total	80	100.0	52	65.0	28	35.0
Physical	12	100.0	5	41.7	7	58.3
Engineering	13	100.0	9	69.2	4	30.8
Life-Gen.	14	100.0	8	57.1	6	42.9
Life-Agr.	13	100.0	10	76.9	3	23.1
Life-Med.	13	100.0	11	84.6	2	15.4
Soc. Sci.	15	100.0	7	46.7	8	53.3

with foreigners are the physical scientists (58.3 percent), the social scientists (53.3 percent) and, to a lesser extent, the life-general scientists (42.9 percent). In addition, by gender, 36.9 percent male and 26.7 percent female; by ethnicity, 29.6 percent Malay, 41.7 percent Chinese, and 29.4 percent Indian; by generation, none first and second generations, 34 percent third generation and 18.2 percent fourth generation. This suggests that female Malaysian scholars are less likely to interact with foreigners in their departments than their male counterparts. Chinese scientists interact more with their foreign associates than do their Malay and Indian counterparts. The third generation of scholars interacts more often with foreign colleagues than do either the first, second or fourth generations. Among these respondents who have continuing professional associations with foreigners who are in residence, three-fourths (75 percent) are working closely and regularly together on common research problems. In contrast, a fourth only visit each other informally. Table 38 suggests the frequency of interactions between the Malaysian scientific community sample and their foreign counterparts within their university setting. The data show that scholars in the general life sciences and physical sciences interact more frequently with their foreign associates in their departments than do scientists in the other disciplines. Four out of five in each of these two scientific areas (83.3 and 80 percent, respectively) indicate that they meet, talk and discuss about their professional and research work as often as once a week or more. The agricultural life scientists are next (66.7

TABLE 38.--Distribution of Frequency of Interaction Between Malaysian Scientific Community Sample Who Have Foreign Colleagues and Their Foreign Counterparts by Major Area of Science.

Major Area of Science	Total Sample		Frequency of Interaction: Interact Once or More a Week		Frequency of Interaction: Interact Occasionally	
	N	%	N	%	N	%
Total	28	100.0	18	64.3	10	35.7
Physical	5	100.0	4	80.0	1	20.0
Engineering	4	100.0	2	50.0	2	50.0
Life-Gen.	6	100.0	5	83.3	1	16.7
Life-Agr.	3	100.0	2	66.7	1	33.3
Life-Med.	2	100.0	1	50.0	1	50.0
Soc. Sci.	8	100.0	4	50.0	4	50.0

percent). In the absence of ideological constraints and language barriers (English being the <u>lingua franca</u> of both Malaysian and foreign scientists) and despite the unplanned nature of their personal ties, there is actually a good bit of openness and regularity to them. The more self-confident as well as the more productive the scientists are, the greater the likelihood for them to be more communicative with their foreign counterparts in their own department.

Extra-Institutional Interpersonal Networks of Scientists

Besides scientists' intra-institutional communication networks, we also examined their extra-institutional ties and personalized relationships with their Malaysian colleagues. The ecological setting of Malaysian institutions of higher education and research centers has a direct bearing on the networking process. Kuala Lumpur being the primate city, as previously depicted, contains most of the members of the society's scientific community. Accessibility is, therefore, governed not by physical space of a large country with a highly dispersed scientific community but by the circumstances for interacting in the environs of a metropolis. Thirty-seven (46.3 percent) respondents report communicating and working closely with their external colleagues and exchanging detailed research and other professional information from time to time.

Of particular interest, however, are the disciplinary areas of the 37 (46.2 percent) who maintain personalized ties with their Malaysian counterparts outside their institution. More than half of the scientists in three disciplinary areas establish contact with Malaysian colleagues outside their own institution: agricultural scientists, 77 percent (10 out of 13); social scientists, 60 percent (9 out of 15); and life-general, 57 percent (8 out of 14). The three science areas that have weaker or minimal ties with their external counterparts within the country are the medical scientists, 31 percent (4 out of 13); physical scientists, 25 percent (3 out of 12); and the engineers, 23 percent (3 out of 13).

By gender, two out of five are males (44.6 percent) and one out of two are females (53.3 percent). By ethnicity, two out of five are Malays (40.7 percent), one out of two are Chinese (52.8 percent), and two out of five are Indians (41.2 percent). By generation, six out of ten are first generation (62.5 percent), one out of two are second generation (57.1 percent), one out of three are third generation (38.3 percent) and a little over one-half are fourth generation (54.5 percent).

Among those 37 scientists with colleagues outside their own institution, 18 respondents (48.6 percent) have contact with only one person and 19 respondents (51.4 percent) with two or more persons. In regard to the nature of their personalized relationships with their external associates inside the country, six (16.2 percent) indicate having worked regularly together; 13 (35.1 percent) have had informal visits with each other both in their offices and at home to have general discussions with each other on professional, intellectual and/or social matters; 12 (32.4 percent) claim to have both worked regularly together as well as having informal visits, and finally, six (16.2 percent) indicate having worked occasionally together whenever there is need.

The distribution of the overall frequency of scientists' communication with their external Malaysian colleagues shows that for respondents who have communication networks with external scientists, two meet once a week (5.4 percent), six meet once in two weeks (16.2 percent), 13 meet once a month (35.1 percent), and 16 meet occasionally whenever circumstances arise (43.2 percent).

In most cases those who interact with colleagues within the university setting are also those who are more likely to interact with their external counterparts. Even though the frequency of communication with their external colleagues is not as often as their frequency of communication with colleagues within their institution, still the findings show some measure of group cohesiveness (proportion of group members chosen as "significant colleagues") between scientists and their external associates. They meet, talk and share their knowledge, skills and experiences with their "significant colleagues." The organization in which scientists' external counterparts are associated are diversified. Five of the respondents (13.5 percent) have ties with colleagues who are employed in agriculturally related institutions (two agricultural scientists and three social scientists); 15 (40.5 percent) have ties with scientists employed in health and medically related institutions. This is especially true of six scientists in life-general, four in life-agriculture, three in physical sciences and one each in engineering and social sciences. Seven (18.9 percent) have ties with industrial or engineering related organizations. They are three social scientists, two medical scientists, one life-general and one life-agriculture scientists. Six (16.2 percent) have ties with educationally related institutions. They are three life-agriculture scientists, two engineers and one social scientist. Two (5.4 percent) have ties with the Economic Planning Unit of the Prime Minister's Department (one social scientist and one life-general scientist). Finally, two (5.4 percent) have ties with the government's Department of Statistics and both of them are medical scientists. Indeed, these findings are indicative of the complex matrix of interconnections created and maintained by scientists with their external significant colleagues.

From the evidence presented on the totality of the networkings of interpersonal relationships between academic-based Malaysian scientists and their "significant colleagues" (Malaysians both within and external to their institutions and foreigners in residence in their university) suggests the existence of a scientific community or what Crane discusses as the "invisible college." Although there are isolates and differential amounts of self-involvement, there is considerable evidence of a community of scholars with a sense of shared interest.

To pursue this further, we studied the nature of the involvement of the sample of Malaysian scientists in more organized scientific groupings in order to complement our review of their interpersonal relationships.

Scientists' Involvement and Participation in Scientific Gatherings Held Inside Malaysia

In the previous section we reviewed the scientists' participation in information exchange activities with their "significant colleagues." We now proceed to look in detail at their involvement with gatherings: conferences, seminars, workshops and colloquia. The groupings of scientists which are bound together in time and space when inspected one at a time often seem ephemeral.

Yet they constitute a social system with its own distinctive structures, norms and styles of behavior. Indeed, there is a regularity in the patterns of initiative on the part of the conveyor and of the recipient of information through which both deliberate and unplanned communication comes about. The scientists at these gatherings may seek one kind of information and obtain another; inform a colleague or audience of current work and be rewarded with a relevant item of information. Information incorporated in papers and brought up spontaneously in duscussions is exchanged. In addition to the main purposes of the gathering, scientists may purposively go to seek out a colleague who has information to convey (Menzel, 1966).

First we will analyze the patterns and variations of Malaysian scientists' participation and involvement in scientific conferences, seminars, workshops, and colloquia held inside the country within the last three years.

Within the last three years, our sample attended three different types of meetings which were held in Malaysia. First are scientific conferences organized by the different Malaysian scientific and professional organizations. Usually, these conferences are an all-Malaysian affair whose participants are primarily Malaysian scientists plus a limited number of Malaysian professionals and policymakers from many different country-based organizations. The second type are Asian scientific conferences held inside Malaysia. Besides Malaysians, participants in these conferences are mainly from countries in Asia, with some from interested attendants from other parts of the world. The third type are international scientific conferences held inside the country. Besides Malaysians, particpants in these conferences are substantially more diversified, compared with the former, and come from many parts of the world.

Scientists' Participation in the Local Malaysian Scientific Gatherings

In terms of participation in the first type, the local Malaysian scientific gatherings, our data show that over three-fourths (77.5 percent or 62 respondents) have attended national scientific conferences, seminars, workshops and colloquia within the last three years.

When comparisons are made among the six scientific areas (see Table 39), there are appreciable differences between them. Engineers are the least involved. A majority of them indicate that there are few organized professional meetings that concern their field of interests. The majority of them are "one of a kind" in their specialized field and hence it is difficult to organize meetings with a tight focus. They have few occasions to participate in a manner that provides them with opportunities to get acquainted and to share and exchange information with "significant colleagues."

In addition, the identity of those who attended were, by gender, male, 76.5 percent and female, 80 percent; by ethnicity, Malays, 81.5 percent, Chinese, 77.8 percent, and Indians, 70.6 percent; by generation, first generation, 62.5 percent, second generation, 92.8 percent, third generation, 70.2 percent, and fourth generation, 90.9 percent. The distribution seems to suggest that in terms of participation in local Malaysian scientific meetings, percentagewise,

TABLE 39.--Distribution of Frequency of Scientists' Participation in Local Malaysian Scientific Gatherings in Last Three Years.

Major Area of Science	Total Sample		Frequency of Participation: Only One Gathering		Two or More Gatherings		None	
	N	%	N	%	N	%	N	%
Total	80	100.0	11	13.7	51	63.8	18	22.5
Physical	12	100.0	1	8.3	10	83.3	1	8.3
Engineering	13	100.0	4	30.8	1	7.7	8	61.5
Life-Gen.	14	100.0	0	0.0	12	85.7	2	14.3
Life-Agr.	13	100.0	2	15.4	10	76.9	1	7.7
Life-Med.	13	100.0	1	7.7	8	61.5	4	30.8
Soc. Sci.	15	100.0	3	20.0	10	66.7	2	13.3

there are no appreciable differences between gender, ethnicity and generations.

The participants in meetings perform various roles: observers, organizers, discussants and presenters of papers. Table 40 offers an account of these role functions of scientists in the different scientific sessions. The most common role is paper presenter; the second most predominant role is observer. We asked some in our sample who had been organizers of some of these meetings about who were the paper givers. They report that oftentimes the paper givers were normally the more eminent scholars in the field. Overall, however, they agree to the fact that their main difficulty

TABLE 40.--Distribution of Scientists' Role in Local Malaysian Scientific Gatherings Attended in Last Three Years.

Role in Gatherings	Number of Gatherings Attended					
	One		Two		Three	
	N	%	N	%	N	%
Total	80	100.0[a]	80	100.0[a]	80	100.0[a]
None attended	18	22.5	40	50.0	60	75.0
Observer	17	21.3	8	10.0	6	7.5
Paper presenter	33	41.3	25	31.3	11	13.8
Paper presenter and organizer	8	10.0	13	16.3	3	3.8
Discussant	5	6.3	6	7.5	3	3.8

[a]Does not add to 100.0 percent because some have more than one role in the gathering.

always is to secure sufficient papers of quality for discussion in the meetings.

With regard to scientists' participation in the Asian scientific meetings held inside the country, the data disclose that only 13.7 percent out of the sample participated in such gatherings. By areas: 16.7 percent, physical sciences (2 out of 12); 15.4 percent, engineering sciences (2 out of 13); 7.1 percent, life-general sciences (2 out of 13); 23.1 percent, medical sciences (3 out of 13); and 6.7 percent, social sciences (1 out of 15). Proportionally, more medical scientists attended Asian scientific meetings than their counterparts in the other disciplinary areas. The roles among all those at these meetings: two were observers, three presenters of papers and six were both organizers and presenters of papers as well.

The social identity of the 11 who attended the Asian scientific meetings were as follows: 16.7 percent of the males; 11.1 percent, Malay, 16.7 percent, Chinese, and 18.8 percent, Indian; 25 percent, first generation, 38.6 percent, second generation, 2.1 percent, third generation, and 18.2 percent, fourth generation. It is, therefore, obvious that among Malaysian scholars attending Asian scientific meetings held inside the country, scientists of male origin were dominant. No female has had the opportunity to attend such meetings. In addition, more Chinese and Indians attend these meetings than their Malay associates, and the senior generation scholars (first and second generations) participated more than the younger scholars.

Even though small in number, all of them are prominent, highly respected, and have established reputations in their fields of specialization inside the country and outside as well.

As for the international scientific meetings held inside the country in the last three years, 19 respondents (24 percent) participated in these gatherings--13 or 16.2 percent have attended only one conference and 6 or 7.5 percent have attended two or more conferences.

The most highly involved of the scientific fields were the agricultural scientists, 38.5 percent (5 out of 13); the medical scientists, 38.5 percent (5 out of 13); and the social scientists, 26.7 percent (4 out of 15). The least involved were the physical scientists, 16.7 percent (2 out of 12); the engineers, 15.4 percent (2 out of 13); and the general life scientists, 7.1 percent (1 out of 14). Perhaps the problems discussed in the three highly participating scientific areas were more related to developing societies and would attract both local participation and the international support. Most of the Malaysian participants in these meetings are scholars who also have attended conferences abroad. One exception are scientists in life-general. Even though few attended international meetings within the country, most of them have attended scientific gatherings held in foreign countries.

In relation to their social identity, the participants are: by gender, 29.2 percent of the males; by ethnicity, 14.8 percent of the Malays, 30.6 percent of the Chinese, and 23.5 percent of the Indians; by generation, 62.5 percent of the first generation, 28.6 percent of the second generation, and 21.3 percent of the third generation. No female and no fourth generation of scientist in our sample have participated in international scientific meetings held inside the country. As in the case of the Asian scientific conferences, the Chinese and Indian scholars participated more in these international scientific meetings as well.

Memberships in Malaysian Professional and Scientific Organizations

The leaders of the Malaysian scientific community have been actively engaged in the establishing of professional associations. Overall, foreigners do not play a major role in the creation of these scientific associations. We could not reconstruct the history of all the attempts to form scientific societies, but it was possible to get partial information from the sample scientists about the 35 societies in which they are involved in one way or another.

Nine out of ten in our sample (91.2 percent) belong to one or several Malaysian scientific societies in their own specialized or related professional fields. By disciplinary areas: 91.7 percent of the physical scientists (11 out of 12); 100 percent of the engineering scientists (13 out of 13); 85.7 percent of the life-general scientists (12 out of 14); 100 percent of the medical scientists (13 out of 13); and 86.7 percent of the social scientists (13 out of 15) belong to Malaysian scientific societies. By gender, male, 98.8 percent, and female, 93.3 percent; by ethnicity, Malay, 88.9 percent, Chinese 91.7 percent, and Indian, 94.1 percent; by generation, first generation, 100 percent, second generation, 78.6 percent, third generation, 93.6 percent, and fourth generation, 90.1 percent. In contrast, only seven respondents (8.7 percent) are not members of any particular scientific society. In most cases they are isolates in the local scientific community. The number of memberships held by the sample in local scientific and professional associations by major area of science are incorporated in Table 41.

The findings in Table 41 disclose that more than one-half of the respondents (55 percent) are affiliated with one scientific society only and 36.3 percent have ties to two or more scientific societies. By scientific areas, the general life sciences (57.1 percent), the medical sciences (53.8 percent) and, to a lesser

TABLE 41.--Distribution of Number of Memberships Held by Scientists in Malaysian Scientific and Professional Organizations by Major Area of Science.

Major Area of Science	Total Sample		Number of Memberships					
			Only One		Two or More		None	
	N	%	N	%	N	%	N	%
Total	80	100.0	44	55.0	29	36.3	7	8.7
Physical	12	100.0	8	66.7	3	25.0	1	8.3
Engineering	13	100.0	11	84.6	2	15.4	0	0.0
Life-Gen.	14	100.0	4	28.6	8	57.1	2	14.3
Life-Agr.	13	100.0	5	38.5	6	46.1	2	15.4
Life-Med.	13	100.0	6	46.1	7	53.8	0	0.0
Soc. Sci.	15	100.0	10	66.7	3	20.0	2	13.3

extent, the agricultural life sciences (46.1 percent) have the greater tendency to become members of two or more scientific and professional associations inside the country than do physical (25 percent), engineering (15 percent) and social science (20 percent).

The main Malaysian scientific societies and journals existing in 1976 as recorded by our sample are given in Table 42.

Of the societies in the physical sciences, the Malaysian Institute of Physics, The Malaysian Institute of Chemistry, The Malaysian Mathematical Society are national in scope but all three were recently formed. These societies have published only bulletins and have yet to publish a learned journal. Nonetheless, within the last three years, they have been active in organizing

TABLE 42.--Malaysian Scientific Societies and Their Main Publication as Reported by Scientists in the Major Areas of Science.

Society	Main Publications
Physical Sciences	
Malaysian Institute of Physics	Bulletin
Malaysian Institute of Chemistry	Bulletin
Malaysian Mathematical Society	Bulletin
Engineering	
Institution of Engineers, Malaysia	Journal & Bulletin
Malaysian Institute of Planners	Journal
Institution of Surveyors, Malaysia	Journal
Life-General	
Malaysian Society for Parasitology & Tropical Medicine	Newsletter
Malaysian Scientific Association	Journal
Malaysian Nature Society	Journal
Malaysian Plant Protection Society	Bulletin
Malaysian Biochemical Society	Proceedings
Life-Agriculture	
Agricultural Institute of Malaysia	Journal, Proceedings
Malaysian Veterinary Association	Journal
Malaysian Society of Animal Production	Bulletin
Malaysian Institute of Food Technology	Bulletin
Malaysian Plant Pathology Society	None
Malaysian Society of Soil Science	None
Society for Advancement of Breeding Research, Asia and Oceania, Malaysian Branch	Bulletin
Life-Medical	
Malaysian Academy of Medicine	Proceedings
Medical Association of Malaysia	Journal
Malaysian Association of Physicians	Newsletter
Neuro-Psychiatric Soc. of Malaysian Med. Assn.	None
Malaysian Society of Anaesthesiologists	Newsletter
Malaysian Society of Pathology	None
Malaysian Pharmaceutical Society	None
Malaysian Society for Pharmacology and Experimental Therapeutics	None
The Royal College of Surgeons, Malaysia	Journal
Obstetric and Gynaecological Soc. of Malaysia	None
Social Science	
Malaysian Society of Asian Studies	Proceedings
The Royal Asiatic Society, Malaysian Branch	Journal
Malaysian Economic Association	Journal
Malaysian Society for Public Administration	Newsletter
National Geographical Association, Malaysia	Bulletin
Family Planning Association, Malaysia	Bulletin

conferences, seminars and workshops to enable their members to come together and to share their knowledge and experiences. They have also sponsored international meetings for sharing in the wider scientific community.

The most important of all the engineering societies is the Institution of Engineers, Malaysia; nearly all practicing engineers in the country belong to it. The society holds a meeting annually, at which most of the papers are of general engineering interests; it also publishes the Journal of Engineering and Institution of Engineers, Malaysia Bulletin. Among the life-general associations, the Malaysian Nature Society is the most important and is international in its coverage. Many scientists in Malaysia, but particularly those in the biological sciences, are members of this society. It holds general meetings annually and publishes a learned journal and proceedings. The Malaysian Nature Society is regarded as the equivalent of the British Nature Society. It publishes papers mostly of geological, botanical and zoological interest and some few papers in other fields. The other three societies were recently formed and have small memberships. Of the three, only the Malaysian Scientific Association publishes its own journal.

Of the six societies in agricultural sciences, the most predominant is the Agricultural Research Institute of Malaysia. It has been established for more than a decade and publishes its own journal. The others were more recently formed.

Among the six scientific areas, the medical sciences have the largest number of professional societies. Nonetheless, not all of them have a learned journal. The one society that is both local and international in orientation is the Medical Association of Malaysia. It is the most distinguished in the medical field and nearly all practicing physicians in Malaysia belong to it. It has been in existence for more than a decade and publishes its own learned journal.

In the social sciences, membership in the different scientific societies is small except for the Malaysian Economic Association. It has not only the largest membership but is also the most prestigious and active social science association. It publishes its own journal and often holds conferences, seminars and symposia. Membership in this association is not confined to persons specializing in economics. It includes academics in the various social sciences and also technocrats and policymakers in the public and private sector.

Although it is difficult to assess rigorously the relative liveliness and impact of different societies, there is little doubt that the more vigorous and enterprising among them include the Malaysian Economic Association, the Malaysian Medical Association, the Agricultural Institute of Malaysia, and the Malaysian Nature Society. Through their conferences, scientific meetings and publications, they have contributed much to the building of a Malaysian scientific community by bringing Malaysian and other scientists together for intellectual exchange of ideas and for the spreading of scientific information through their publications.

A majority of the respondents whom we interviewed agree to one important dimension: that is, the scientific conferences, meetings and publications organized by their respective societies do provide them with forms of stimulation and inspiration in their scientific work. From the activities of their societies they get new ideas, have chances to make direct contact and to consult with their more eminent colleagues at scientific meetings, and have a sense of being part of a larger effort.

Most of the other scientific societies in the country were recently formed and are still developing. It is premature to expect them to have a forceful impact on the scientific community. It would be interesting to see in the next few years if these nascent professional scientific societies do become major networks for binding together the scientists inside the country, for exercising national leadership in science policy questions and for contributing significantly to the generation of new scientific cultures.

The Dissemination of Knowledge: Communication of Research Results

In the previous section we have described the interchange and sharing of scientific and technical information among university-based Malaysian scientists that occur in a variety of formal and informal ways: in face-to-face talk with "significant colleagues" both within and outside their institution; with Malaysians as well as with foreigners, through conferences--national, regional and international held inside the country; through meetings organized by scientific societies inside the country in which scientists are participants.

Still other media for sharing results of research activities include: progress reports on current research, technical reports to sponsoring agencies, the so-called "open literature" consisting of professional scientific journals, printed proceedings of conferences, books, theses, ordinary correspondence, pamphlets and news releases, being guest speakers at other institutions, sending of reprints, sessions with advisory groups, and so forth. In the following we will present first: (a) the principal avenues used by Malaysian scientists for transmitting the results of their research work; and then, second, (b) the scientists' perceptions of the end users of their research results in the country.

Principal Avenues for Communicating Results of Research Activities

While there are widely disparate professional habits among persons with regard to their communication patterns, there are five principal avenues for the dissemination of the results of their research activities to interested persons in and out of the Malaysian scientific community. These are (1) publication in scientific and technical journals (the "open literature"); (2) conferences, meetings, seminars, workshops and colloquia; (3) visits with "significant colleagues" at other institutions; (4) formal lectures at other institutions; and (5) theses.

In Table 43 it is evident that scientific and technical journals are the main outlet for conveying research results in all

TABLE 43.--Distribution of the Principal Avenues for Communicating Results of Research Work of Sample Scientists by Major Area of Science.

Principal Avenues for Communicating Research Results	Major Area of Science													
	Total		Physical		Engin.		Life-Gen.		Life-Agr.		Life-Med.		Soc. Sci.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	12	100.0	13	100.0	14	100.0	13	100.0	13	100.0	15	100.0
Scientific and technical journals	31	38.7	5	41.6	4	30.7	7	50.0	5	38.4	5	38.4	5	33.3
Conferences, seminars, workshops and colloquia	16	20.0	3	25.0	2	15.4	3	21.4	2	15.4	3	23.1	3	20.0
Formal lectures	7	8.8	0	0.0	1	7.7	0	0.0	0	0.0	4	30.7	2	13.3
Informal visits with colleagues at other institutions	11	13.7	0	0.0	2	15.4	3	21.4	3	23.1	0	0.0	3	20.0
Sending reprints	5	6.3	2	16.7	2	15.4	0	0.0	1	7.7	0	0.0	0	0.0
Theses	9	11.2	2	16.7	2	15.4	1	7.1	2	15.4	1	7.7	1	6.7
Books/monographs	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	6.7

major areas of science in Malaysia. More than a third (38.7 percent) of all the respondents indicated having utilized this medium. Perhaps this is to be expected because whatever the private motivation of scientist-contributors, the scientific periodicals serve two major roles: as vehicles for the communication of new discoveries and ideas, and as a repository of knowledge. Moreover, the ultimate purpose of learned journals is not profit but the promotion of knowledge and the advancement of science and technology. If we recall, in Chapter III, each of the scientific disciplines has one or several scientific and technical journals in which scientists may publish their research results. These journals, even though some are of better quality and more prestigious than others, do provide within their own fields useful and reliable sources of information to their readers. They serve the purpose of enabling their readers to keep up with changes and the best of them contribute much which retains its usefulness long after publication.

Second to scientific and technical journals as the means utilized to disseminate the results of their research work inside Malaysia are conferences, seminars, workshops and colloquia. One in five (20.0 percent) indicate having used this medium. As we observed in previous sections, these gatherings may be on a national, Southeast Asian or international level, under the auspices of private and public agencies or with the cosponsorship of scientific and technical societies, foundations, governments, and so forth. Subjects discussed in the meetings attended by our sample were as varied as the interests and specialties of the scientists who participated.[15]

Our respondents usually assess these gatherings as valuable sources of information for those who attend and, for those who did not attend, there were the published versions of papers and discussions. One respondent aptly summarized:

> The functions of conferences, seminars, workshops and colloquia are not those which ostensibly motivate the bulk of our programs, but other forms of communication--corridor meetings, the presence in one room of those interested in one single area, face-to-face contact with an inference of informality--all these taken together can be an effective means of acquiring, exchanging and disseminating information.

Conferences, seminars and workshops and their reports have characteristics which make them exceptionally important and sometimes vital sources of information in Malaysia. To reformulate the points made earlier, documents are the foremost sources of securing and disseminating new findings but scientific information is also obtained and disseminated through people talking and listening to each other. Our data also show that some of these respondents utilized non-documentary sources, such as visiting their "significant colleagues" at other institutions to inform them about their research activities and results. Some also are invited as guest

---

[15]Some of the subjects discussed ranged from physicists and chemists in national development, national utilization of land resources, industrial design, engineering hydrology, crop protection, plant tissue culture, marine pollution in East Asian waters, agro-waste utilization, livestock production, psycho-tropic medication, development in Southeast Asia, research on human resources and issues, local government and development administration in Southeast Asia, to the multinational corporation--its implications for developing countries.

speakers to talk about their research work and results. Those scientists who report visiting their associates or serving as guest speakers have records of being among the more productive in their scientific work. To give an example: an eminent medical scientist at the primate university has been frequently invited by health-related institutions in the country to speak about his current research on family planning and childbirth.

Nine respondents (11.2 percent) are currently involved in research for a doctoral thesis. All are regular staff members of the faculty of different academic institutions and are at the same time doctoral candidates.[16] The subjects chosen for theses necessitate some original work which makes them potentially valuable sources of information to people concerned with the subject. Also, some of these dissertations will later form the basis for fully published articles, monographs or books.

Finally, five respondents (6.3 percent) distribute or send reprints as a way of informing others about their studies. This is especially true of two physical scientists (16.7 percent), two engineers (15.4 percent) and one agricultural scientist (7.7 percent). Only one respondent reports writing a book based on his research work and none has written a textbook. Needless to say, Malaysian scholars primarily depend on foreign textbooks and journals for references in their scientific work. The distribution of

---

[16] Out of the nine, seven will submit their theses to their respective institutions inside the country. The other two will be submitting their theses to foreign universities.

pre-prints and other kinds of individually reproduced papers (e.g., mimeographed documents and reports) has not as yet become part of the circulation process inside the scientific community.

The most frequently utilized medium for dissemination of research findings are the scientific and technical journals and conferences, seminars, workshops and colloquia. The most striking feature emerging from this study of communicating systems is the relatively small proportion of the research results that are disseminated in the forms of pre-prints, reprints, books and monographs. The reason for this can only be speculated about and await further investigation. There may be basic cultural constraints on an individual's taking the initiative in passing on their papers to others in Malaysia. It may be the lack of inexpensive duplicating facilities. Not writing books may be attributed to the state of the publishing business. The culture has yet to accept the practice that scholars on their own initiative can send out their publications to professional colleagues unless requested. This is because they do not wish to be regarded as too ostentatious. However, this is not true in their interpersonal ties with foreigners in the country and abroad.

The Perceived End Users of the Scientists' Research Results

Having asked the sample scientists to itemize which avenues they relied on to communicate and disseminate their research findings we further asked them to indicate whether or not the results of their own research have been actually utilized by any specific group in the country. In constructing this question we were mindful of the complexity of the concept "useful." There is a subtle and potential usefulness related to ideas and information which have been derived from "rational" procedures and which are incorporated into a "modern" world-view. This is, in part, what a scientific community is all about. But from the immediate and narrower perspective of particularistic end-users, we tried to learn what our sample perceived as the consequences of their own work in varied sections of the national society. Their responses to the question are given in Table 44.

The findings are informative about the differences in the types of knowledge--basic-oriented or applied-oriented--that have been utilized by the various sectors of the total society as reported by 40 scientists (50 percent) in our sample. Clearly, the data disclose that the results of applied studies done by scientists have greater tendency of being used by the different sectors inside the country, e.g., agriculture, medical, education, and other scientists. Nearly two out of five (38.8 percent) scientists engaged in applied-oriented studies perceived that their research results have been utilized. In contrast, one out of ten (11.2 percent) scientists engaged in basic research disclose that their research findings have been used. On this score we hypothesize that scientists who are involved in practical-oriented studies have the greater opportunity to relate themselves and their own work in varied sections of the national society.

TABLE 44.--Distribution of Sectors Perceived by the Scientists as Having Used Their Research Findings, Classified by Types of Research.

Sectors Perceived by Scientists As Using Findings	Total		Types of Research			
			Basic		Applied	
	N	%	N	%	N	%
Total in sample	80	100.0	33	41.2	47	58.8
Total who see them used	40	50.0	9	11.2	31	38.8
Agriculture	13	16.2	3	3.8	10	12.5
Medical	7	8.7	1	1.2	6	7.5
Education	6	7.5	0	0.0	6	7.5
Commerce and industry	5	6.3	2	2.5	3	3.8
Engineering (building and construction)	5	6.3	3	3.8	2	2.5
Other scientists	4	5.0	0	0.0	4	5.0

Our methodology and the time available to carry out the study precluded the search for the impact of the perspective of science, the influence of new sources of "modern" knowledge on the culture of Malaysia and the infrastructures of development. Instead, we had to impose a more limited search for understanding of the interaction between science and society in a developing country in the third world. We chose to omit, for instance, the transmission of new modes of thinking and new information to students by research scholars acting as teachers, the diffusion of ideas and proposals from the scientific community to the political community, various socioeconomic classes and to the different linguistic-ethnic groupings. We cannot take into account the feedback process in which the ties with outside groups in turn influence the outlook and work interests of the scientists.

In the following section we will continue analyzing the dissemination of scientific information, but this time by looking at scientists' roles as consultants and/or technocrats to many different groups and organizations inside the country or abroad.

Dissemination of Knowledge and Technology: Scientists As Consultants

The services of indigenous scientists as technical consultants may be drawn upon by the state, by large commercial and industrial enterprises, service industries, public utilities, foreign foundations, multinational corporations, international aid organizations and other agencies that have to do with the social and economic development of a new country. It is of no small significance, therefore, that local sources of consultative and advisory help are rapidly becoming available in many developing countries of the third world and that these services are likely to expand with time. As modern institutions and political economies of these countries become more viable and their need for expert assistance grows and the commitment to building an authentic base become stronger, independent academics/scientists are needed to offset the risk of overdependency on foreigners for technical advice which leads to dependency and neo-colonialism. Equally crucial, a formal bureaucratic system in the social structures of a developing middle-sized, third-world country requires a range of expertise which a university system can provide on temporary loan or part-time basis (Arcega, 1976). Malaysia has opted especially for the part-timers as consultants and advisers.

The practice of engaging part-time local consultants will undoubtedly grow. Viewed in this historical context, our analysis centers on the role of Malaysian academic scientists as consultants to (1) public and private enterprises inside the country, and (2) regional, international and country-related organizations. We then asked questions about the norms which enter into the characteristics of their role functions as consultants.[17]

Domain of Consultantship: Domestic, Public and Private Enterprises

In the selective transfer of world-wide or locally derived knowledge, in making choices on appropriate technology and in getting at the critical issues in program development, scientists can be valuable resources for a developing country. For the scientist, the role of consultant has the potential of articulating their professional concerns into the mainstreams of society and their exercising some influence in the organization and administration of the developing institutions. The entire transaction is complex and this study could deal only with selective aspects of role performance.

---

[17]For the purpose of this study, a consultant is defined as a person turned to by a client organization because of one's specialized knowledge, skills and experiences, to act as an advisor or to assume part-time responsibility for a specific technical task or action program. He is not always paid for his services.

We found that out of the total sample, 33 (41.2 percent) were technical consultants and/or advisors to the national government, 6 (7.5 percent) were consultants to state governments, 16 (20 percent) were consultants to various professional and scientific organizations, and 5 (6.2 percent) were consultants to local community organizations.

Of particular interest are the scientists' advisory roles to the Malaysian national government and its subsidiary instrumentalities and to Malaysian private industry and business. Taking these two institutions can illustrate the role of scientists as consultants in domestic public- and private-related institutions in the country. Table 45 contains the distribution of the number of scientists who are consultants to the Malaysian national government and its related agencies by gender, major area of science and ethnicity.

It appears that out of our total sample, two out of five scientists (41.2 percent) are consultants to the national government and its instrumentalities. Among them one out of four (26.2 percent) are technical consultants to various ministries of the government, e.g., agriculture, health, youth culture and sports, education and science technology, and environment; 7.5 percent to a research institute, e.g., MARDI (Malaysian Agricultural Research and Development Institute); 2.5 percent to semi-government agencies, e.g., Kuala Lumpur City Hall; 5 percent to other national agencies, e.g., the National Narcotics Bureau, the Economic Planning Unit, the National Unity Board and the National Family Planning Board.

TABLE 45.--Distribution of Scientists' Role as Consultants in Different Types of Malaysian National Government and Its Agencies by Gender, Major Area of Science and Ethnicity.

Gender, Area of Science, & Ethnicity	Total Sample		Total Govt. Related Consultant Role		Type of Government Agency: Ministry		Research Institute		Semi-Govt. Organiz.		Others	
	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	33	41.2	21	26.2	6	7.5	2	2.5	4	5.0
Gender												
Male	65	100.0	30	46.2	18	27.7	6	9.2	2	3.1	4	6.2
Female	15	100.0	3	20.0	3	20.0	0	0.0	0	0.0	0	0.0
Major Area of Science												
Physical	12	100.0	3	25.0	3	25.0	0	0.0	0	0.0	0	0.0
Engineering	13	100.0	6	46.2	4	30.8	1	7.7	1	7.7	0	0.0
Life-Gen.	14	100.0	5	35.7	3	21.4	1	7.1	1	7.1	0	0.0
Life-Agr.	13	100.0	8	61.5	4	30.8	4	30.8	0	0.0	0	0.0
Life-Med.	13	100.0	5	41.7	2	15.4	0	0.0	0	0.0	3	23.1
Soc. Sci.	15	100.0	6	40.0	5	33.3	0	0.0	0	0.0	1	6.7
Ethnicity												
Malay	27	100.0	13	48.1	9	33.3	3	11.1	1	3.7	0	0.0
Chinese	36	100.0	11	12.2	9	25.0	0	0.0	0	0.0	2	5.6
Indian	17	100.0	9	52.1	3	17.6	3	17.6	1	5.9	2	11.8

Looking more closely at subsections of the sample and comparing the six areas of science, predominant indications are that groups that are most visible in providing consultancy services to the government and its related agencies are the life-agriculture scientists (61.5 percent), engineering scientists (46.2 percent), life-medical (41.7 percent) and social scientists (40 percent). There is reason to believe that scientists who are in disciplines which are closely linked to high priority ventures in the social and economic development of the country and for which there is a scarcity of high-level scientific manpower in the existing bureaucracies are more likely than others to function as part-time technocrats for the government and its agencies. This is maximized if there are experienced persons on both sides in dealing with each other in these various fields. The least currently involved are the general life scientists (35.7 percent) and physical scientists (25 percent). Even these figures are fairly high when compared to some neighboring scientific communities in Southeast Asia. In comparison with the above groups, however, this may simply be due to the fact that policymakers and administrators in the public sectors are not aware of the potential benefits or of how to make use of the talents of the individuals in these professional fields and a lack of contact or experience by the scientists in knowing how to proceed in building bridges.

In comparing male and female scientists, we found that two out of five male scholars (46. 2 percent) and only one out of five (20 percent) females were consultants to the national government and its agencies. Men were more diversified in their consulting activities. For instance, 27.7 percent of the men were consultants to the different ministries of the government, 9.2 percent to research institutes, 3.1 percent to semi-government agencies and 6.2 percent to the other units. In contrast, women were more restricted in their consultantships; all of the three women scholars in the role were consultants primarily to ministries. The somewhat low level and more confined scope of female participation in consultative work cannot be considered particularly surprising if it is borne in mind that positions as consultants presently are available to persons with high status in the academic community and with those who have an established reputation in the scientific world and experience and expert knowledge in the field. In Malaysia, presently, there are few women who are senior academic scientists with such social attributes. It is, therefore, not uncommon for their low-level representation as consultants.

In the case of ethnicity, almost one out of two Malays (48.1 percent), and one out of two Indians (52.1 percent) were consultants to the government and its subsidiary units. In contrast, only one out of ten Chinese (12.2 percent) were consultants to the same agencies. We can interpret these results by connecting them to the ethnic networks of the larger society which facilitate Malay academic scientists having better linkage systems with the upper-level policy and management circles of the government which are predominantly Malayan. Thus, in making appointments of technical consultants and advisors to the governmental organizations, the ascribed attribute of ethnic identity and cultural background enters into consideration along with the achievement norms of knowledge and skills. Accordingly, professionally competent Malays with experience in a particular field are more likely to be appointed if they are available. As a case in point, one out of three (33.3 percent) of the sample Malays were consultants in varied ministries of the national government, compared to one out of four of the Chinese (25 percent) and 17.6 percent of the Indian sample. Similarly, one out of ten Malays (11.1 percent) and one out of six Indians (17.6 percent) and no Chinese were consultants to MARDI.

Aside from being consultants to the Malaysian government and its subsidiary units, members of our sample were also technical consultants to Malaysian private industry and business. Table 46 provides the figures on the scientists' role as consultants to Malaysian industry and business.

For the total sample, slightly more than one-fourth (27.5 percent) were consultants to Malaysian-owned local private industries and business firms. Among these 15 percent have been consultants to engineering, building and construction-related industries; 5 percent, to the chemical industry; 3.8 percent, to food-related industry; 2.5 percent, to plantation firms, and 1.2 percent, to electronic industry.

Between scientific disciplines the highest rates of participation in consultative activities in Malaysian private industry and business firms occurs among the engineers, agricultural life scientists and physical scientists. For instance, three out of four

TABLE 46.--Distribution of Scientists' Role as Consultants in Different Types of Malaysian Private Industry by Gender, Major Area of Science and Ethnicity.

Gender, Area of Science, & Ethnicity	Total Sample		Total Private Related Consultant Role		Type of Private Industry									
					Plantation		Chemical		Eng'ring. Building/ Constr.		Electronic		Food	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	22	27.5	2	2.5	4	5.0	12	15.0	1	1.2	3	3.8
Gender														
Male	65	100.0	20	30.8	1	1.5	4	6.2	12	18.5	1	1.5	2	3.1
Female	15	100.0	2	13.2	1	6.6	0	0.0	0	0.0	0	0.0	1	6.6
Major Area of Science														
Physical	12	100.0	4	33.3	1	8.3	2	16.7	1	8.3	0	0.0	0	0.0
Engineering	13	100.0	10	76.9	0	0.0	0	0.0	9	69.2	1	7.7	0	0.0
Life-Gen.	14	100.0	1	7.1	0	0.0	0	0.0	0	0.0	0	0.0	1	7.1
Life-Agr.	13	100.0	5	38.5	1	7.7	1	7.7	1	7.7	0	0.0	2	15.4
Life-Med.	13	100.0	1	7.7	0	0.0	0	0.0	0	0.0	0	0.0	1	7.7
Soc. Sci.	15	100.0	1	6.7	0	0.0	0	0.0	1	6.7	0	0.0	0	0.0
Ethnicity														
Malay	27	100.0	4	14.8	0	0.0	0	0.0	3	11.1	0	0.0	1	3.7
Chinese	36	100.0	13	36.1	2	5.6	2	5.6	6	16.6	1	2.7	2	5.6
Indian	17	100.0	5	29.4	0	0.0	1	5.9	3	17.6	0	0.0	1	5.9

engineers (76.9 percent), almost two out of five agricultural scientists (38.5 percent) and one out of three physical scientists (33.3 percent) have been sought by local private enterprises. Keeping in mind our earlier findings with respect to consultancy to the government and its units, we find some comparative results. Six out of ten scientists in agriculturally related sciences (61.5 percent) have been consultants to the government and almost two out of five (38.5 percent) to the private sector. The consulting services of scientists in life-general and life-medical are in demand primarily in the government sector. In contradistinction, engineering scientists (76.9 percent) and physical scientists (33.3 percent) are more commonly involved in consultancy roles with the private sector than they are with the government. In contrast to the above, 46.2 percent of the engineers and 25 percent of the physical scientists function as advisors to the state. The services of the social scientists are the least sought by both the public and private sector.

In relation to gender, men are more likely than women scientists to be approached by clients for consultative work in locally owned private industry and business firms, e.g., 30.8 percent in the former and 13.2 percent in the latter.

Classified by ethnicity, one out of three Chinese (36.1 percent) have been participating in consultative work in the local private sector and business firms. In contrast, only 29.4 percent of Indian scientists and 14.8 percent of Malays have done so. There are not as many experienced and highly qualified Malay academic scientists and, to a lesser extent, Indian scientists in the fields of physical and engineering sciences which would enable them to participate in consultancy services. Moreover, the management and control of the private industry and business firms have been Chinese dominated. Thus it is expected that besides the norms of achievement of knowledge and expertise, the sub-cultural norms of ethnic identity, cultural background and other value systems would be brought into consideration when appointing persons as consultants and technocrats.

Domain of Consultantship: International, Regional and Foreign Country's Organizations

Consultative activities of the Malaysian scientific community extend beyond local public agencies and private industry and business firms into Southeast Asian regional organizations, e.g., ASEAN (Association of Southeast Asian Nations), SEAMEO (Southeast Asian Ministers of Education Organization); international organizations, e.g., WHO (World Health Organization), UNESCO (United Nations Educational, Scientific and Cultural Organization), IAEA (International Atomic Energy Agency), and World bank; foreign organizations, e.g., MACEE (Malaysian American Commission for Educational Exchange), Ford Foundation, the China Medical Board of USA, and Von Humboldt Foundation of West Germany. Table 47 shows the numbers who were consultants to regional and international organizations by gender, major area of science and ethnicity.

One out of five (20 percent) were consultants to regional and/or international agencies. Thus, 6.3 percent were consultants

TABLE 47.--Distribution of Scientists' Role as Consultants in Different Types of Regional and International Organizations by Gender, Major Area of Science and Ethnicity.

Gender, Area of Science, & Ethnicity	Total Sample		Total Regional & Intern'l.		Type of Regional/International Organization											
					ASEAN		SEAMEO		WHO		UNESCO		IAEA		World Bank	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	16	20.0	5	6.3	3	3.8	2	2.5	4	5.0	1	1.2	1	1.2
Gender																
Male	65	100.0	12	18.4	5	7.7	2	3.1	1	1.5	3	4.6	1	1.5	0	0.0
Female	15	100.0	4	26.8	0	0.0	1	6.7	1	6.7	1	6.7	0	0.0	1	6.7
Major Area of Science																
Physical	12	100.0	2	16.7	0	0.0	0	0.0	0	0.0	2	16.7	0	0.0	0	0.0
Engineering	13	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Life-Gen.	14	100.0	4	28.4	1	7.1	1	7.1	1	7.1	0	0.0	1	7.1	0	0.0
Life-Agr.	13	100.0	3	23.1	2	15.4	1	7.7	0	0.0	0	0.0	0	0.0	0	0.0
Life-Med.	13	100.0	2	15.4	1	7.7	0	0.0	1	7.7	0	0.0	0	0.0	0	0.0
Soc. Sci.	15	100.0	5	33.3	1	6.7	1	6.7	0	0.0	2	13.2	0	0.0	1	6.7
Ethnicity																
Malay	27	100.0	3	11.1	2	7.4	0	0.0	0	0.0	1	3.7	0	0.0	0	0.0
Chinese	36	100.0	9	25.0	3	8.3	1	2.8	0	0.0	3	8.3	1	2.8	1	2.8
Indian	17	100.0	4	23.6	0	0.0	2	11.8	2	11.8	0	0.0	0	0.0	0	0.0

to ASEAN; 5 percent, to UNESCO; 3.8 percent, to SEAMEO; 2.5 percent, to WHO; and 1.2 percent each to IAEA and the World Bank. Virtually all of these scientists are the more active, productive and eminent in their respective fields of specialization. Their contacts and affiliations with these different types of social organizations provide them with extra networks for scientific communication to a worldwide scientific community.

When we explore specific variables (gender, area of science and ethnicity), we find some revealing disparities. For the six areas, one of three persons (33.3 percent) in social sciences, one out of four (28.4 percent) in life-general were the most frequently used by the respective regional and/or international agencies for consultative and advisory activities. As for the medical scientists, only three out of twenty (15.4 percent) were consultants to those agencies. The findings in part serve to illuminate the selective involvement of particular fields by the different agencies which transcend national boundaries. Probably, this is because the research work of scientists in these fields and their findings are envisioned as having some third-world practical implications and usages: agriculture, public health and socioeconomic development. The physical and engineering sciences were not extensively tied into this transnational network.

The life-general and the social scientists were more diversified in their activities, being consultants to ASEAN, SEAMEO, WHO, IAEA, UNESCO and the World Bank, respectively. The life-agricultural scientists were primarily consultants to ASEAN and SEAMEO, and the medical scientists to ASEAN and WHO.

In regard to the differences between male and female Malaysian academic scientists, almost one out of five male scholars (18.4 percent) against one out of four female scholars (26.8 percent) were consultants to regionally and/or internationally related organizations. This implies that gender is not a major constraint for selection as consultants and advisors to major regional or international bodies. What matters, in reality, are visible academic persons with research reputations and achievement in the Malaysian scientific community as exemplified by both selective male and female scholars in our sample. Individually, they are both professionally active and productive in their fields.

Among ethnic groups one out of four Chinese (25 percent) and almost one out of four Indians (23.6 percent) perform as consultants whereas only one in ten Malays (11.1 percent) consult to both the regional and international bodies. The former two ethnic groups were consultants to many agencies including ASEAN, SEAMEO, UNESCO, IAEA and the World Bank, whereas the Malays were confined to two organizations--ASEAN and UNESCO.

Finally, only five (6.2 percent) in the total sample were consultants to the foreign private and public organizations which are tied to particular countries. These organizations are MACEE, Ford Foundation, the China Medical Board of USA, and Von Humboldt Foundation, West Germany. None have consultantship roles with the multinationals. In most cases, persons who were consultants to the government and domestic private industry and business firms were also those who have had consultantship roles to the regional and international agencies.

Norms in the Selection of Consultants

The choice of the "right" academic scientist having the training, experience, capabilities, connections and the preferred qualities desired to fulfill a role and to carry out a project lies in part with the client organization. The norms and behavior inside this organization falls beyond the scope of this study. Nevertheless, we have asked the scientists about the manner in which they were chosen as consultants as well as their own conceptions of the professional and social attributes which are appropriate for being selected as consultants by the different organizations. They were asked to indicate whether or not their selection as consultants in each instance started primarily with their own initiative in which they approached specific clients with offers of their services or, on the other hand, they were initially approached by their clients, or the transaction was mediated by some segments of the government, recommended by their institution or sponsored by someone influential in the society or elsewhere around the world.

Their responses show that one out of three (35 percent) in the sample were directly approached by their future clients for their services. Of the rest, 7.5 percent were approached by their academic institutions, 6.2 percent were sponsored by someone influential both in the society and elsewhere abroad, 8.8 percent were selected after their own self-initiative to approach the relevant agencies, and 2.5 percent were specially recommended by the national government. This suggests that academic scientists in the country are most apt to become consultants to the public and private industry or business firms in Malaysia and/or to regional, international and foreign country's organizations on the initiative of the agencies that seek their services and contact them through institutional or personal sponsorship.[18] Indeed, few on their own initiative approached any particular institution or agency to offer their knowledge and services.

When we take into account the three variables of gender, areas of science and ethnicity, we do not find any appreciable differences among them in the mode of selection as consultants. Scientists in the six disciplinary areas, male and female, and in the three ethnic groups generally agreed that they were picked to become consultants either because they were originally sponsored by some influential policymaker or senior executive.

Social Factors in the Selection of Consultants

Insofar as Malaysian academic scientists are self-conscious of the process of choice, there are six perceived factors that influenced their own selection as consultants and/or advisors. Of these, three are most commonly emphasized and significant:

---

[18]Among those sponsored, two were by a Minister in the cabinet of the national government; six were by top administrators of the scientists' own institution; two were by senior executives of business firms and one was by a foreigner.

(1) expert knowledge about a particular domain where there is a scarcity of viable networks (60 percent); (2) a degree from a foreign institution (41.3 percent); (3) outstanding reputation in the field within the scientific community of Malaysia (38.8 percent). The three elements ranked as somewhat less important but still having some influence on their selection as consultants are (4) the ability to interact easily with people in the organization and related sector (17.5 percent); (5) the ability to speak fluent English (17.5 percent); and (6) having an influential sponsor (6.3 percent).

When we explore further, our findings, as reported in Table 48, reveal that there are variations among the six scientific areas. While there are no extreme differences between persons in the six areas in terms of their perceptions of the three highly esteemed values as a consultant ("expert knowledge," "foreign degree," "outstanding reputation"), with regard to "ability to interact," "fluency in English," and "influential sponsor" there are differences among the different disciplines. Physical, engineering, and life-general scientists are less convinced than the other three groups that "ability to interact" easily with people is an important criterion in terms of becoming a consultant. The medical, physical and social scientists do not consider that "fluency in English' is a an especially important element. Finally, polarized with the agricultural, medical and social sciences, no physical, engineering and general life scientists feel that an "influential sponsor" is necessary for them to become a consultant to an organization.

TABLE 48.--Distribution of Factors Important in the Selection of Scientists as Consultants by Gender, Major Area of Science and Ethnicity.

Gender, Area of Science, & Ethnicity	Total Sample		Factors Important in the Selection as Consultants: Foreign Degree		Expert Knowledge		Outstanding Reputation		Ability to Interact		Fluency in English		Influential Sponsor	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	33	41.3	48	60.0	31	38.8	14	17.5	14	17.5	5	6.3
Gender														
Male	65	100.0	29	44.6	43	66.2	29	44.6	14	21.5	11	16.9	4	6.2
Female	15	100.0	4	26.7	5	33.3	2	13.3	0	0.0	3	20.0	1	6.7
Major Area of Science														
Physical	12	100.0	6	50.0	7	58.3	3	25.0	1	8.3	2	16.7	0	0.0
Engineering	13	100.0	6	46.2	10	76.9	9	69.2	1	7.7	4	30.8	0	0.0
Life-Gen.	14	100.0	4	28.6	5	35.7	5	35.7	1	7.1	2	14.3	0	0.0
Life-Agr.	13	100.0	5	38.5	9	69.2	3	23.1	4	30.8	3	23.1	3	23.1
Life-Med.	13	100.0	3	23.1	6	46.2	5	38.5	3	23.1	0	0.0	1	7.7
Soc. Sci.	15	100.0	9	60.0	11	73.3	6	40.0	4	26.7	3	20.0	1	6.7
Ethnicity														
Malay	27	100.0	11	40.7	14	51.9	10	37.0	3	11.1	0	0.0	2	7.4
Chinese	36	100.0	18	50.0	23	63.9	13	36.1	9	25.0	9	25.0	1	2.8
Indian	17	100.0	4	23.5	11	64.7	8	47.1	2	11.8	5	29.4	2	11.8

[a] Does not add to 100.0 percent because some chose more than one factor.

When distinctions are made between male and female respondents of their perceptions of the traits influencing their selection as consultants, we find that roughly two out of three men (66.2 percent) in our sample, in contrast to only one out of three women, agreed that "expert knowledge" is a very significant element. They also differ about the importance of other traits. More men than women stressed "outstanding reputation," "ability to interact" easily with people as important criteria. About the same proportion of each, one out of five women (20 percent) compared to three out of twenty men (16.9 percent), considered having a "foreign degree" an important factor in their selection.

With very few exceptions, we do not find pronounced contrasts between Malays, Chinese and Indians in their perceptions of the factors influencing their selection as consultants. The pattern in Table 48 indicates that irrespective of their ethnic origin they generally agreed that "foreign degree," "expert knowledge" and "outstanding reputation" are by far the most important factors considered by their potential clients to become consultants. However, it must also be borne in mind that these factors are, in fact, additional to the more implicit factors taken into consideration by future clients regarding the selection of their potential consultants such as ethnic-linguistic origin, political affiliation and other social cultural factors. Factors such as "ability to interact," "fluency in English" and "influential sponsor" are considered as of secondary importance. However, Indians (23.5 percent), in contradistinction to Malays (40.7 percent) and Chinese (50 percent), do not consider "foreign degree" as a major asset in terms of their selections as consultants. Similarly, no Malays, in contradistinction to Chinese (25 percent) and Indians (29.4 percent), do not consider that "fluency in English" an important dimension.

The process of becoming a consultant to an organization may change as the scientific community and Malaysian institutions mature or shift their values and relationships with one another.

Role Functions of the Consultant

Table 49 shows the more definitive sets of activities as consultants provided by the consultants in our sample of study. The most influential and most common role is that of contributing advice on policy questions in relationship to institutional plans and progress (45 percent). Consider, for instance, the case of one senior and eminent medical scientist who, at the time of this study, was a member of the National Maternal and Child Health Advisory Council of the Ministry of Health. His major role was to advise the senior staff of the ministry on both the need for and how to develop, organize and implement plans for maternal and child health care in the country.

The second common role is to evaluate individual projects or action-programs of public agencies. Twenty-nine (36.3 percent) were involved in such undertaking. For instance, two economists were engaged in evaluative studies concerning national economic plans on labor utilization and public enterprise development in

TABLE 49.--Distribution of the Types of Role Functions of Scientists as Consultants by Major Area of Science.

Major Area of Science	Total Sample		Type of Role Function as Consultant													
			Tech. Advice		Evaluate Programs		Special Studies		Develop Scheme		Provide Leader-ship		Develop Research		Lectures/ Seminars	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	36	45.0	29	36.3	26	32.5	20	25.0	14	17.5	11	13.8	10	12.5
Physical	12	100.0	6	50.0	6	50.0	5	41.7	4	33.3	1	8.3	1	8.3	0	0.0
Engineering	13	100.0	9	69.2	5	38.5	7	53.8	5	38.5	2	15.4	1	7.7	0	0.0
Life-Gen.	14	100.0	5	35.7	3	21.4	3	21.4	2	14.3	2	14.3	2	14.3	1	7.1
Life-Agr.	13	100.0	7	53.8	7	53.8	3	23.1	3	23.1	1	7.7	4	30.8	2	15.4
Life-Med.	13	100.0	3	23.1	2	15.4	4	30.8	1	7.7	3	23.1	2	15.4	2	15.4
Soc. Sci.	15	100.0	6	40.0	6	40.0	4	26.7	5	33.3	5	33.3	1	6.7	5	33.3

[a]Does not add to 100.0 percent because some have more than one type of role function.

Malaysia. Another was formulating and evaluating programs for national integration in Malaysia's multiracial society.

The third most common role-related activity of consultants is to undertake special studies. Twenty-six persons (32.5 percent) reported having carried out a high percentage of mission-oriented investigations. Some of these include studies on investment climate in Malaysia, nonformal education, the development of methods for the efficient use of facilities and materials in industries (e.g., a shoe factory, the milk industry), appraising the technical-economic feasibility of setting up a cattle project in the country, studies on the identification of the severity of floods and recommendations of measures to be developed to control floods in the country. In addition, there are more limited tasks such as developing a technological system and projects for a particular agency (25 percent); providing temporary professional leadership in innovative programs (17.5 percent); developing research to help solve some specific questions or problems (13.8 percent); and, finally, providing seminars and lectures to groups, e.g., doctors, nurses, administrators, or teachers who were attending new and special training programs (12.5 percent).

Among scientific disciplines, the assembled data (see Table 49) disclose that both the physical and engineering scientists were less involved in such activities as providing lectures and seminars, developing research and development projects, and providing leadership in a project or scheme. This implies that scientists in these two fields are less likely to be engaged in research and in providing leadership in projects in their fields in organizations outside the academic institutions. The life-scientists were generally more active except in one or two categories. For instance, scientists in life-general were less prone to give lectures and seminars to specific groups; agricultural scientists, like the physical scientists and the engineers, were less likely to be selected as leaders of projects or programs in their consultative activities. The medical scientists were least involved in developing technological systems and projects for a specific organization. Finally, social scientists were generally active in all types of consultative work except in the area of developing research and development. This may be true because social science research and development in the country has not been well developed and organized compared to research in other fields, particularly the life sciences and, to a lesser extent, the physical and the engineering sciences.

Overall, we do not find any appreciable differences between male and female scientists in regard to their roles as consultants except in that of developing technological systems and projects. Of the twenty respondents (25 percent) in this category, all were men. The same commonality is exhibited by the three ethnic groups--Malay, Chinese and Indian.

In the prevailing literature on the sociology of science, the scientific norms prescribe that rewards are allocated to individuals solely on the basis of their achievements; in proportion, that is, to the magnitude of their individual contribution to the advancement of knowledge. In other words, recognition is allocated to an individual to the extent to which he has fulfilled his scientific role as a creator of new knowledge. The same literature is virtually silent on the rewards which stem from the transmission of new knowledge to end-users and accordingly no attempt has been made to codify the norms of achievement on the score. To study the emerging norm we first listed seven types of reward that seem most likely to be achieved by scientists in relation to their consultative work. These rewards are (1) opportunities to learn new problems, (2) opportunities to contribute knowledge and skills, (3) opportunities to gain additional reputation, (4) opportunities to bring prestige to own university, (5) opportunities to popularize own professional field, (6) opportunities to get support for research funding, and (7) opportunities to gain additional income.

We then asked our scientists who have had experience as consultants to identify which of these rewards they feel as having been fulfilled as the result of their work-role as consultants. Table 50 provides the distribution of the seven types of reward achieved by scientists by major area of science.

Overall, the results show that there are four pronounced rewards against three less pronounced rewards achieved by scientists. Of the former the most predominant is the "opportunities to learn new problems." Almost half (47.5 percent) of the Malaysian academic scientists suggested so. This is followed by "opportunities to contribute to knowledge and skills." We find that two out of five (40 percent) of the scientists acknowledged the importance of receiving such rewards in their consultancy work. Besides, one out

TABLE 50.--Distribution of the Types of Reward Achieved by Scientists by Major Area of Science.

Major Area of Science	Total Sample		Type of Reward: Learn New Problems		Contrib. Knowl./ Skills		Addt'l. Repu-tation		Bring Prestige to Own Univ.		Popu-larize Own Field		Get Sup-port for Research Funding		Addt'l. Income	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	38	47.5	32	40.0	30	37.5	25	31.3	19	23.4	13	16.3	11	13.8
Physical	12	100.0	6	50.0	1	8.3	5	41.7	4	38.3	2	16.7	0	0.0	3	25.0
Engineering	13	100.0	10	76.9	5	38.5	6	46.2	6	46.2	4	30.8	0	0.0	4	30.8
Life-Gen.	14	100.0	4	28.6	4	28.6	3	21.4	2	14.3	2	14.3	4	28.6	0	0.0
Life-Agr.	13	100.0	6	46.2	9	60.2	7	53.8	6	46.2	6	46.2	3	23.1	1	1.2
Life-Med.	13	100.0	5	38.5	4	30.1	3	23.1	3	23.1	1	7.7	1	7.7	0	0.0
Soc. Sci.	15	100.0	7	46.7	9	60.0	6	40.0	4	26.7	4	26.7	5	33.3	3	20.0

[a]Does not add to 100.0 percent because some received more than one type of reward.

of three (37.5 percent) admitted that "opportunities to gain additional reputation" is important. Less than a third (31.3 percent) considered "opportunities to bring prestige to own university" as also an important contribution. The less apparent are "opportunities to popularize own professional field" (23.4 percent), "opportunities to get support for research funding" (16.3 percent), and "opportunities to gain additional income" (13.8 percent).

However, among the scientific disciplines, the findings reveal some variations in the distribution of the rewards attained. For the first type of reward, "opportunities to learn about new problems," with the exception of engineering sciences in which three out of four (76.9 percent) considered such reward important, there is only slight variation among the scientific areas. On the second type of reward, "opportunities to contribute to knowledge and skills," few physical scientists (8.3 percent) consider this as an achievable reward based on their experience. As for the third type, "opportunities to gain additional reputation," again the patterns manifest a slight spread with the life-agricultural scientists (53.8 percent), and engineering (46.2 percent), physical (41.7 percent) and social scientists (40 percent) being more inclined than others to accept the norm that their consultative roles would enhance their professional and scholarly reputations. The fourth type is "opportunities to bring prestige to own university." With the exception of general life scientists (14.3 percent) and social scientists (23.1 percent) who were less prone to consider such as forthcoming, we do not find any significant discrepancies between the fields.

Among the less pronounced rewards--"opportunities to popularize own professional field," "opportunities to get support for research funding" and "opportunities to gain additional income"--the responses disclose some interesting variation. For instance, two out of five agriculturally related scientists (46.2 percent) consider that their consultative roles would provide them with the avenues to popularize their own professional field in the larger society. In contrast, the medical scientists (7.7 percent) do not consider such reward as occurring. This probably reflects the present low status of agriculture and the high status of medicine in Malaysia. Both the life-general (28.6 percent) and the life-agriculture (23.1 percent) scientists expect to secure research funds from these sources and expect little or nothing in added personal income. The physical (25 percent) and engineering (30.8 percent) scientists expect to receive monetary reward as additional personal income. Perhaps the difference is that the latter are more likely to be consulting with profit-making organizations.

The purpose of this chapter has been to trace the patterns of and variations in the linkages of scientists within the context of the Malaysian scientific community and segments of Malaysian society and in the process to determine how knowledge is transmitted among scientists and between them and end-users. In a real sense they are one of the gatekeepers to the world of science within

Malaysian society. In the next chapter, we will address the trans-societal networks of scientists and the patternings and variations of their third cultural interpersonal ties.

CHAPTER V

THE TRANS-SOCIETAL NETWORKS OF SCIENTISTS AND THE PATTERNING OF THEIR THIRD CULTURE OF SCIENCE

In the previous chapter, we have discussed the patterns of networks among scientists within the national society. Now we turn to the trans-societal networks of Malaysian scientists and the patternings of their third culture. The purpose of this chapter is to answer the questions: How do Malaysian academic scientists establish trans-societal networks? what channels are employed by them in building and maintaining such networks? and what are the different types of networks created?

These trans-societal networks will be considered from two viewpoints. First to be considered are the phenomena which influence the building of scientists' third cultural networks. Here we will discuss (a) our sample's reference groups as to leading centers abroad of the respondents' professional field; (b) the scholars in similar fields of research abroad who are personally known by them and with whom they have professional ties; (c) conferences attended in foreign countries; and (d) membership in foreign scientific and professional societies.

Second, we will look at the characteristics of the Malaysian third culture of science as it relates to total scientific disciplines or science epicenters and to the personal networks of the Malaysian scientists themselves. We will endeavor to understand network bonds by examining (a) the characteristic elements of this third culture, (b) the present functions of third cultural networks for the Malaysian scientific community, (c) the different modes of participation in scientific third cultures and the different attachments that develop, as well as (d) Malaysian scientists' conceptions of their scientific roles. For the modalities that occur and/or the different kinds of scientific networks, a number of factors will be considered. They are gender, area of science, ethnicity, highest degree earned, place of education for highest degree, generation and university affiliation.

Establishing Trans-Societal Networks

Trans-societal networkings among scientists have long existed but with the demise of colonialism, the nature of these linkages changed as scientists became embedded in a new world system. The interdependence between scientists in the developed and the less-developed societies has led to the incremental growth of knowledge and the spread and exchange of ideas in the global world but the nature of the relationship has changed somewhat.

Every Malaysian institution of higher education which we studied is tied into a network of relationship which transcends national boundaries. All Malaysian scientists have personally encountered foreigners in their professional activities either in Malaysia or abroad. Consequently, interpersonal ties have developed between Malaysian scientists and their foreign counterparts who are located in other countries. There are a number of ways in which scientists establish and maintain personalized trans-societal relatonships, among them are going abroad for graduate training and attending scientific conferences, seminars and workshops. Nevertheless, in order to understand the matrix of such trans-societal ties, we have first to consider the general distribution around the world of trained scientists and the reputational ranking of countries, institutions and laboratories with respect to the training of scientists and the furthering of knowledge. Those countries, institutions and laboratories which are perceived as crucial in the advancement of knowledge and hence are preferred places for the education of future scientists, represent to the Malaysian scientists the epicenters of global science.

Perceptions of Malaysian Scientists As to the Global Epicenters of Their Professional Fields

While our sample of scientists differs among themselves in their cognitive maps as to the epicenters of science for their professional fields, none had difficulty in identifying the present location of their own field's epicenter. They could specify the part those at the epicenters have played not only in the recent development of their specialized field but also, for many, the way the scholars and institutions at the center had facilitated their own education and contributed to their research and professional careers. These reference groups are viewed as being significant centers of intellectual and technical creativity in their own professional field and their scientific performance constitute the highest world standards. They are defined as comprising a sizable number of working scientists who are the creators of the prevailing research paradigms or are engaged in studies on the growing edges of knowledge in their fields. Without any hestitation, members of our sample would strongly recommend their own best students to study for their graduate training at these particular centers of science. Table 51 shows the location of the centers of science in each individual's own professional field by major area of science.

From this table it can be generalized that three out of four in our sample of Malaysian scientific community identify two epicenters of global science, the United States and Great Britain. But they divide almost equally in appraising these two centers: 38.7 percent consider the United States and 36.2 percent Great Britain as the primary reference group for science. Three-fourths of the sample look mainly to these two countries for their paradigms and models for scientific roles, for the books, journals, preprints, etc., they read, for the professional forum in which their own work is critically appraised for its contribution to science and world-respected recognition accorded for scientific accomplishments. They are also the places to which they have established transsocietal interpersonal ties. Other countries in Europe, Australia/New Zealand, Canada and India appear visible as intellectual centers for one out of three. The absence of some regions on their cognitive maps may be explained to some degree by linguistic barriers,

TABLE 51.--Distribution of the Perceived Location of the Leading Epicenters of Science in Scientists' Own Professional Field by Major Area of Science.

Major Area of Science	Total Sample		Location of Epicenter											
			Great Britain		U.S.A.		Europe		Austr. /N.Z.		Canada		India	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	29	36.2	31	38.7	7	8.8	4	5.0	3	3.8	6	7.5
Physical	12	100.0	2	16.7	5	41.6	3	25.0	0	0.0	2	16.7	0	0.0
Engineering	13	100.0	9	69.2	2	15.4	0	0.0	1	7.7	1	7.7	0	0.0
Life-Gen.	14	100.0	8	57.1	4	28.6	0	0.0	0	0.0	0	0.0	2	14.3
Life-Agri.	13	100.0	1	7.7	9	69.2	1	7.7	1	7.7	0	0.0	1	7.7
Life-Med.	13	100.0	5	38.4	5	38.4	1	7.7	1	7.7	0	0.0	1	7.7
Soc. Sci.	15	100.0	4	26.7	6	40.0	2	13.3	1	6.7	0	0.0	2	13.3

political and economic isolation, and weak cross-cultural relationship between Malaysia and some countries with viable science communities (i.e., Japan, U.S.S.R., mainland China). In contrast to the humanities in Malaysia, which contain scholars with growing interests in other cultures (as, for instance, the Middle-East), the epicenters of world science continue through the Malaysian sample of generations studied to remain fairly confined.

Malaysians in various scientific fields exhibit different clusters in locating the epicenters of world science in their professional fields. Agricultural scientists (69.2 percent) and social scientists (40 percent) visualize the United States as the foremost center for their professional field with Great Britain second. The engineers (69.2 percent) and the general life scientists (57.1 percent) appraise Great Britain as the global leader with the United States second. The physical scientists are more divided in their choices. While 41.6 percent regard the United States as the major center for physical sciences, 25 percent consider one or another country in Europe, and 16.7 percent put Great Britain first. An interesting sidelight is the medical scientists. Despite the fact that over 90 percent of them received their post-graduate training in Great Britain, more than a third of them (38.4 percent) rank Great Britain and the United States as equally important in being the dominant centers for research in the medical field.

We have reviewed thus far the main locations in the world of science centers as designated by Malaysian scientists with reference to their fields. Our underlying hypothesis is, therefore, that our sample will more than likely establish networks between themselves and colleagues in the larger world scientific community who are located at these known and respected foreign scientific centers, and with whom they can easily communicate because of a common language (English) and opportunities to interact freely on their own initiative. In the following section we examine the foreign scholars who are known personally and with whom they have personalized relationships in the different foreign scientific centers. Please note that we exclude from this part of our report the foreign scientists who presently live and work in Malaysia. They were reported on in the previous chapter.

Scholars in Other Countries in Similar Fields of Research Known Personally by Malaysian Scientists and With Whom They Interact

An important sociological basis for trans-societal linkages is a network of informal contacts between scientists which allow for a continuous and easy flow of ideas and information. Personalized contacts between scientists from developed and developing societies are one of several ways in which knowledge transfer can take place. The amount of information which is being exchanged at international conferences, at meetings of scientific societies, orally or through private letters and personally circulated preprints is seemingly much larger than that which goes through more formal channels of communication. Most scientists informally exchange their research ideas with others long before formal publication takes place.

The Malaysian scientists in our sample have built up informal and sometimes elaborate systems of networking for the exchange of information through letters, conference schedules, pre-prints and reprints with their colleagues abroad. More than four out of every five in our total sample (83.7 percent) know, communicate with and maintain interpersonal ties on a continuing basis with "significant colleagues" in foreign countries. The number of foreign colleagues with whom they have interpersonal ties is given in Table 52.

There are wide differences among our scientists in the number of scholars in foreign science centers whom they personally know and with whom they keep in touch. At one end of the range, 38.8 percent communicate with one or two persons, and at the other end, 45 percent have ties with three or more scholars. One-sixth (16.2 percent) have no ties with scientists at their science epicenters. By scientific areas, among those who have ties with only one or two foreigners, the most dominant are agricultural scientists (61.5 percent), physical scientists (50 percent) and medical scientists (46.1 percent). In comparison, among those who have ties with three or more colleagues are general life scientists (71.4 percent), engineering scientists (61.5 percent) and social scientists (60 percent). Among those who have no ties with foreigners, 30.8 percent are medical scientists and 23.1 percent agricultural scientists. The lower proportion of ties of the medical community may reflect its greater internal strength in Malaysia, whereas the agricultural sciences may be too young to yet have pervasive networks.

TABLE 52.--Distribution of the Number of Foreign Colleagues With Whom Malaysian Academic Scientists Have Interpersonal Ties.

Major Area of Science	Total Sample		Number of Foreign Colleagues With Whom Interact: One or Two		Three or More		None	
	N	%	N	%	N	%	N	%
Total	80	100.0	31	38.8	36	45.0	13	16.2
Physical	12	100.0	6	50.0	4	33.3	2	16.7
Engineering	13	100.0	4	30.8	8	61.5	1	7.7
Life-Gen.	14	100.0	3	21.4	10	71.4	1	7.1
Life-Agr.	13	100.0	8	61.5	2	15.4	3	23.1
Life-Med.	13	100.0	6	46.1	3	23.1	4	30.8
Soc. Sci.	15	100.0	4	26.7	9	60.0	2	13.3

The countries of the foreign scholars with whom our sample communicate and have personal ties are given in Table 53. There are several modal patterns. First, more than two-thirds of our sample (68.8 percent) have ties with counterparts in Great Britain. The proportions having interpersonal networks with British scientists varies by major area of sciences. It is high for medical scientists (92.3 percent), physical scientists (91.7 percent), the general life scientists (85.7 percent), and the engineering scientists (69.2 percent). The binational British-Malaysian third cultures remain strong in these fields. It is low for agricultural life scientists (15.4 percent). The British during the colonial period did not have

TABLE 53.--Distribution of Foreign Scholars with Whom Members of the Malaysian Scientific Community Have Personal Ties, by Place of Residence of Foreign Scholars and by Area of Science of Malaysian Scholars.

Major Area of Science	Total Sample		Home Country of Foreign Scholars with Whom Scientists Have Ties																No Foreign Country Ties	
			Great Britain		United States		Austr. /N.Z.		Canada		Europe		India		Japan		S.E. Asia			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	55	68.8	34	42.5	30	37.5	12	15.0	11	13.8	3	3.8	2	2.5	27	33.8	13	16.2
Physical	12	100.0	11	91.7	2	16.7	5	41.7	3	25.0	2	16.7	0	0.0	0	0.0	0	0.0	2	16.7
Engineering	13	100.0	9	69.2	3	23.1	6	46.2	3	23.1	0	0.0	0	0.0	0	0.0	4	30.8	1	7.7
Life-Gen.	14	100.0	12	85.7	12	85.7	5	35.7	0	0.0	6	42.9	1	7.1	2	14.3	6	42.9	1	7.1
Life-Agr.	13	100.0	2	15.4	4	30.8	7	53.8	1	7.7	1	7.7	0	0.0	0	0.0	5	38.5	3	23.1
Life-Med.	13	100.0	12	92.3	1	7.7	3	23.1	2	15.4	1	7.7	1	7.7	0	0.0	3	23.1	4	30.8
Soc. Sci.	15	100.0	9	60.0	12	80.0	4	26.7	3	20.0	1	6.7	1	6.7	0	0.0	9	60.0	2	13.3

[a]Percentages do not add to 100.0 percent because some have linkages with foreign scholars in more than one country.

a high development in agricultural sciences, nor has it since independence. Second, the expansion of cross-cultural relations in recent years between Americans and Malaysians is expressed in the figures that 42.5 percent of our sample scientists have personal ties with Americans in the United States. The incidence of these particular ties are especially large in the life-general (85.7 percent) and the social sciences (80 percent).

While these findings strengthen the earlier hypothesis, we now need to add some qualifications. Close to a third of our sample (33.8 percent) report having personal ties with colleagues in Southeast Asia (Thailand, Singapore, Indonesia, and the Philippines). Personal networkings are proportionally numerous among social scientists (60 percent), life-general (42.9 percent) and agricultural (38.5 percent). All told, they represent the outcomes of newer organized efforts to foster regional cooperation in higher education with respect to some of the sciences and the emergent interests in some scholarly circles to generate regional networks and a sense of commonality among the Southeast Asian countries.

The discrepancy between the sample's identification of Australia-New Zealand as an epicenter of work in their field (5 percent) and the proportion of them who have personal ties with fellow scientists in this part of the world (37.5 percent) can be explained, by inference, to the exceptionally rapid growth of opportunities for Malaysians to go for advanced studies, conferences, or scholarly tour visits to these countries. The two largest centers of science in Asia today, India and Japan, do not loom large on our sample's cognitive map and only 3.8 percent of them have personal ties with any scientists in India and 2.5 percent with fellow scientists in Japan.

Although the total with ties to scientists abroad is large there are gradations in these figures by disciplines. The general life scientists (92.9 percent) and engineering scientists (92.3 percent) contain the greatest proportion of their members with ties to foreigners abroad; the social scientists (86.7 percent) and physical scientists (83.3 percent) rank close to the median, while the agricultural (76.9 percent) and medical (69.2 percent) are the least involved. Perhaps this is due to the fact that agricultural and medical sciences to a large degree have stronger supporting systems within the national scientific community. For some in these fields, maintaining ties with foreigners abroad is not considered as their foremost concern.

A higher percentage of men (86.2 percent) than women (73.3 percent) have network ties with scientists abroad. This is not unexpected since women have marginal roles within the Malaysian scientific community, thereby limiting the range of their interpersonal ties with scholars abroad.

By ethnicity, the rank order from high to low in having personal ties with individual scholars in other countries is Chinese (88.9 percent), Indians (88.2 percent) and Malays (74.1 percent).

To probe beneath the surfaces of these personalized relationships between members of our sample and their foreign associates, we now consider in more detail how these ties were created and the different status levels of the foreign scholars, the frequency and manner in which scientists communicate with them and the specific dyadic exchanges of science materials and services taking place between them.

Turning to the way in which these dyadic interactions are built and the status levels of the foreign scholars, our findings indicate some interesting clues. The most frequent sources of binding stem from an earlier relationship with professors and other graduate students in the same field in a foreign university or research center. One in five continue in regular interaction with their former professors in the country where they studied. We would stress that a good intellectual relationship had been worked out when they were graduate students. They understand each other's manner of thinking and can quickly zero in on the points of intellectual exchange. Besides former professors, some scientists also retain ties with their former graduate student cohorts whom they knew and had worked with before (33.8 percent). This is especially the case for medically related scientists (61.5 percent). Next, 15 percent have personal ties with individuals whom they had met while visiting research centers or while doing post-graduate work during a sabbatical leave at foreign institutions. The remainder established ties either during the foreign scholar's visit to Malaysia (7.5 percent) or at professional and scientific meetings abroad (7.5 percent).

The frequency of communication with their foreign colleagues varies from scientist to scientist. Almost a third (33.8 percent) in all the scientific disciplines communicate on the average once every six months. The frequency of correspondence for the rest of the respondents is unevenly distributed. It varies from once a month (13.7 percent), once in two months (6.2 percent), once in three months (8.8 percent) up to once a year (3.8 percent). Then there are some (17.5 percent) who simply say occasionally and when there is need.

Looking closely at our sample of scientists at work, there is a web of reciprocity and exchange which links the Malaysian scientific community and their foreign counterparts. We have asked each of them to indicate "how these foreign scholars have helped them in their scientific work" and, similarly, "how they in turn have helped their foreign counterparts." Table 54 provides the patterns of the scientists' responses to our questions.

The kinds of scientific help obtained by Malaysian scientists from their foreign counterparts include initiating collaboration in research, reading and commenting on research manuscripts, securing publications, equipment, specimens, post-graduate placement, hosting during visits, and exchanging research data. The aggregate suggests that the most common role of the foreign scholars is to read and comment on the manuscripts sent to them by their Malaysian counterparts prior to formal publication. More than one-half of the total sample (59 percent) mention this. Furthermore, these foreigners often eventually help in the placing of these manuscripts for publication in foreign scientific journals.

TABLE 54.--Nature of Scientific Help Extended by Foreign Scholars to Malaysian Scientists and by Malaysian Scientists to Foreign Scholars.

Nature of Scientific Help	Extended by Foreign Scholars to Malaysians		Extended by Malaysian Scholars to Foreigners	
	N	%	N	%
Total	80	100.0[a]	80	100.0[a]
Initiate collaboration in research	36	45.0	19	24.0
Read manuscripts	47	59.0	14	18.0
Secure publications	28	35.0	12	15.0
Secure equipment/ apparatus	10	13.0	1	1.3
Secure specimens	11	14.0	16	20.0
Secure post-doctoral appointments	5	6.3	1	1.3
Hosts during visits	20	25.0	24	30.0
Exchange research data	2	3.0	2	3.0

[a]Percentages do not add to 100.0 percent because some extended more than one type of scientific help.

The most highly involved in this process are the general life scientists (79.8 percent), closely followed by the social scientists (67 percent), engineering scientists (62 percent) and physical scientists (58 percent). The medically related scientists (46 percent) and the agricultural scientists (39 percent) are less involved.

The next most common role of the foreigners is to initiate collaboration in research with their Malaysian colleagues. Slightly less than one-half of our sample (45 percent) were approached for such activities. The largest proportionate amount of collaboration occurs among the life-medical scientists (69 percent) and the general life scientists (50 percent). It is less frequent among the other disciplines: physical science (25 percent), engineering (23 percent), agriculture (31 percent) and the social scientists (27 percent). The third role-related activity is rendering assistance for securing publications. Roughly 35 percent of Malaysian scientists received such help from their foreign associates. This occurs more often for the general life scientists (50 percent) and social scientists (47 percent) than for agricultural scientists (38.5 percent), physical scientists (25 percent), engineering (23 percent) and medically related scientists (23 percent). The fourth activity consists of the foreigners becoming a host during visits made by their Malaysian colleagues. A fourth of our sample have been the guest of a foreign scientist in the years since they completed their foreign education and subsequently returned to Malaysia. Other activities of the foreigners, such as providing help in securing equipment/apparatus, specimens, materials, post-doctoral placement, and exchange of research data, are less often cited by the sample.

In exchange for the supporting services extended to them by their foreign colleagues, Malaysian scientists provide other forms of help to their foreign colleagues. Table 54 reveals that the most typical help given is being hosts during visits of their foreign "significant colleagues" to Malaysia. Three out of ten in our sample (30 percent) have hosted foreign scholars during their visits to Malaysia. The highest proportion were the agricultural scientists (46 percent), general life scientists (43 percent) and social scientists (33 percent).

The second important role is collaboration in research. Twenty-four percent indicate they extended research opportunities to foreign colleagues. The most prominent participants in initiating joint studies are the agricultural and medical life scientists. One out of five scientists (21 percent) in both of these two fields have shared at least one of their studies with foreign associates.

The third important role is that of securing agricultural, zoological and botanical specimens requested by foreign scientists. One out of five scientists in our sample has responded to such requests, made special collections and sent them to their foreign colleagues. Most of them are in general (43 percent) and agricultural (23 percent) life sciences. Reading and commenting on research manuscripts written by foreigners before they submit them for publication has been done by nearly a fifth of the sample.

Up to now, we have been discussing the extent and patterns of exchange in scientific activities between the Malaysian scientific community sample and their foreign "significant colleagues." We can conclude that while the norms of reciprocity between them endure, a large majority of the sample are more frequently dependent on their foreign associates than their foreign counterparts are on them for scientific help and services. Further, we can also conclude that the life scientists, particularly the general and medical and, to a lesser extent, agricultural, are the disciplinary groups most actively participating in exchange with foreigners. The social scientists fall at midpoint in most of these activities. The least engaged in a system of reciprocity and mutual exchange with foreigners in their work roles are the physical and engineering scientists.

In the following section, we will discuss the scientists' participation in conferences held around the world.

Conference Attendance in Foreign Countries by Malaysian Scientists

Nowadays, ideas, social technology and knowledge move on an increasing scale across national boundaries, not only through research publications but also through direct contact, discussions and exchange of views at scheduled meetings. The opportunities to attend and participate in conferences, seminars and workshops and to informally confer at these sessions with working scholars having shared interests seem vital to large segments of a scientific community, especially those who feel somewhat isolated in peninsular Malaysia. We discussed our scientists' attendance and participation in professional meetings held inside Malaysia some time in the three years prior to our study. Now we turn to our sample's attendance at foreign conferences, seminars and workshops.

The findings from Table 55 indicate that two-thirds have participated in at least one conference, seminar or workshop in a foreign country during the three years prior to our study. Slightly more than one-third of the sample (33.8 percent) went to only one foreign meeting and another third (33 percent), two or more meetings.

TABLE 55.--Distribution of Malaysian Scientific Community Sample by Proportion Who Attended Foreign International Conferences, by Place Attended, by Number of Conferences Attended and by Average Number per Person for Three Years Before This Study.

Place Attended	No. Attending Foreign Conference	% of Total Sample Attending	No. of Foreign Conferences Attended	Average No. Conferences per Person Attending
Total	53	66.3	91	1.72
Great Britain	8	10.0	11	1.38
U.S.A.	12	15.0	15	1.25
Europe	12	15.0	14	1.17
Australia/ New Zealand	11	13.8	14	1.27
Canada	2	2.5	3	1.50
Southeast Asia	19	23.8	28	1.50
India	3	3.8	3	1.00

A larger portion of the Malaysian scientific community (63.3 percent) than the Philippine scientific community (51 percent) have taken part in international conferences (Useem, Useem, and McCarthy, forthcoming). But the average number of conferences participated in per person is fewer for Malaysian scientists (1.72) than Philippine scientists (4.63). Perhaps this is due to the fact that it is a general policy of the Malaysian scientific community to share opportunities for attending conferences abroad among its members, the more prominent scientists attending important conferences and the less eminent scholars attending conferences that are less distinguished in nature, whereas the Philippines has no such norm.

The concentration of meeting attendance in the same countries which are perceived as the epicenters of world science and with which Malaysians have personal ties comes as no surprise. But the correlations are not as close as one might have expected. Continental Western and Eastern Europe, especially the Netherlands, Switzerland, and U.S.S.R. and, notably, Southeast Asia are the meeting sites for relatively larger numbers of conferences than would be predicted from the cognitive maps and personal ties of Malaysian scientists. The relatively larger number of meetings held in Southeast Asian countries is the result of the growing interest among the policy-makers and scholars of these nations to build up closer Southeast regional cooperation and understanding for the growth and development of knowledge. To some extent it is paralleled by international organizations holding regional conferences for Southeast Asia.

Approximately half in the physical, engineering and agricultural sciences have managed to get to one foreign conference. The physical engineering sciences being newly and less fully developed fields in the country, many in these areas are just now beginning active careers of research and the institutionalization of their specialities. With the exception of a few instances, much of the work done in these fields in the country has yet to have a recognized impact within the national society and across national frontiers. Although the agricultural sciences have a longer history in Malaysia, most of the agricultural scientists are in the younger generation who are working in new research traditions and have yet to establish their professional reputations in the world system of science. In addition, the one-conference participants are predominantly affiliated with the newer universities (49 percent) in contrast to those in the primate university (28 percent).

The medical (54 percent), the life-general (43 percent) and the social scientists (40 percent) have been participants in one or more conference held outside the country. An obvious contributing factor to their active participation in overseas meetings is the availability of funding both from their own institutions and other support systems. More importantly, Malaysians in the life-medical and life-general and, to a lesser extent, the social sciences, more than the rest, have far-reaching extensive and/or intensive networks abroad. They keep themselves well informed on conference schedules in foreign countries. Furthermore, their empirical work which is oriented toward economic, health and ecologically related problems of an underdeveloped society coincides with the current world interest in holding scientific conferences on development of these areas of concern to the third world.

Sixty percent of the women and 28 percent of the men have attended only one scientific meeting. We suggest that women are less likely to attend than men because women have marginal status in academic institutions. They average less number of years in university service. They have low administrative involvement (over and above the organization of their courses), less influential positions in both the academic and scientific communities. Furthermore, except for three cases, most of them have engaged in types of research which do not receive the international recognition that would enable them to be invited to some conferences abroad. There were extremely few female Malaysian scholars working in academic institutions prior to independence. Moreover, when measured in terms of research publications, men are further along in their careers and hence have relatively more productive records than the women who are largely in the younger generation. Therefore, Malaysian male scholars presently are more in the forefront in science development and activities in Malaysia than women.

Among ethnic groups, a large ratio of Malays have attended only one conference (48 percent) in contrast to the Chinese (29 percent) and Indians (25 percent). Our explanation for such differences is that most Malays are recently foreign-returned, young in generation and new arrivals in the scientific community. They currently are working in the newer and less established universities in the country. Being newcomers on so many scores, they often exhibit more concern over developing their roles, the incorporation of their fields in university projects and in publishing their first results. For many it seems a bit premature to expect that they would be recognized for contributions to the larger society and the wider world scientific community. Under these circumstances, they are less likely to have opportunities to participate in international meetings in a foreign country.

In terms of generation, the senior generation of Malaysian scientists are the most active internationally in attending meetings. Three out of four of the first generation of scholars (75 percent) and three out of five of the second generation (64 percent) have attended two or more gatherings held abroad in the past three years. The senior generation of scholars includes several able individuals of highly respected reputations who have made a name in their specialty by virtue of their years of productive research and, in addition, hold high status in the academic community and have many ties with the government. In contrast, among the younger scientists, 21.3 percent of the third generation and 18.2 percent of the fourth generation have attended two or more meetings held in a foreign country.

Demographic Count of the Participants and Non-Participants in Trans-Societal Networks

Of the 80 academic-based research scientists sampled, 67 (83.3 percent) participate to some degree in networks with foreign scholars who live in foreign countries. The purpose of this section is to enumerate the chief demographic characteristics using our selected set of variables to guide the factual inventory. The multiple circumstances which influence the incidence and type of participation is deferred until the following section of the chapter. Tables 56 and 57 summarize these sets of data. It is instructive to first ask the question: Who are the thirteen scientists with no trans-societal personal networks? We can specify three different categories: (1) some are individuals who have the potential of establishing personalized ties abroad at some time in the future, but have not done so up to now because of the newness in their professional role. (2) Others have been so heavily involved in

TABLE 56.--Distribution of Malaysian Scientific Community Sample by Gender, Ethnicity, Area of Science and Generation as to Participation or Non-Participation in Third Cultural Networks.

Characteristic of Sample	Total Sample		Third Cultural Network			
			Participants		Non-Participants	
	N	%	N	%	N	%
Total	80	100.0	67	83.8	13	16.2
Gender						
Male	65	100.0	56	86.1	9	13.8
Female	15	100.0	11	73.3	4	26.7
Ethnicity						
Malay	27	100.0	20	74.1	7	25.9
Chinese	36	100.0	32	88.9	4	11.1
Indian	17	100.0	15	88.2	2	11.8
Area of Science						
Physical	12	100.0	10	83.3	2	16.7
Engineering	13	100.0	12	92.3	1	7.7
Life-Gen.	14	100.0	13	92.9	1	7.1
Life-Agr.	13	100.0	10	76.9	3	23.1
Life-Med.	13	100.0	9	69.2	4	30.8
Soc. Sci.	15	100.0	13	86.7	2	13.3
Generation						
First	8	100.0	6	75.0	2	25.0
Second	14	100.0	11	78.6	3	21.4
Third	47	100.0	40	85.1	7	14.9
Fourth	11	100.0	10	90.9	1	9.1

TABLE 57.--Distribution of Malaysian Scientific Community Sample by Highest Degree Earned, Country of Highest Education, University Affiliation as to Their Participation in Third Cultural Networks.

Characteristic of Sample	Total Sample		Third Cultural Network			
			Participants		Non-Participants	
	N	%	N	%	N	%
Total	80	100.0	67	83.8	13	16.2
Highest Degree Earned						
Bachelor	1	100.0	1		0	0.0
M.B.B.S.	12	100.0	8	66.7	4	33.3
Master	20	100.0	16	80.0	4	20.0
Doctorate	47	100.0	42	89.4	5	10.6
Country of Highest Education						
Malaysia	10	100.0	9	90.0	1	10.0
Philippines	1	100.0	1		0	0.0
India	1	100.0	0	0.0	1	
Australia/New Zealand	14	100.0	12	85.7	2	14.3
Canada	6	100.0	5	83.3	1	16.7
United States	9	100.0	7	77.8	2	22.2
Great Britain	39	100.0	33	84.6	6	15.4
University Affiliation						
Primate university	51	100.0	44	86.3	7	13.7
Newer universities	29	100.0	23	79.3	6	20.7

administrative roles or extra-scholarly pursuits in private or public life that they have curtailed their research and active communication with scientists in foreign countries. They often spend much of their professional role in different sectors of the society and they derive their satisfaction from the consulting they do. For these individuals, recognition for achievement in their field is a means for achieving other ends such as high status position, extra monetary reward, and prestige in the Malaysian society at large. (3) There are also several who have a foreign education but who for ideological reasons do not wish to have contacts with foreigners in Malaysia or in a foreign country. For them, interacting and communicating with foreigners is interpreted as not in their best interest or in the interest of the country. They feel culturally nationalistic in the sense of wanting to build a knowledge base and develop an appropriate technology in accordance with what best fits the tradition of the country and society. They prefer no direct foreign participation for themselves nor do they want indirect foreign influences impinging on Malaysian culture. In contrast to those scientists who have a Malaysian focus to their work and yet maintain ties abroad, these scientists believe that both the professional work and identity of Malaysian scientists should be, as far as possible, established within Malaysian national boundary and culture.

Having identified the isolates from international science networks, we now briefly survey the participants in any transnational networks.

Area of Science

There is a high proportion of persons in all the six scientific areas with networks abroad. Most active are the life-general (92.9 percent) and the engineering scientists (92.3 percent). Close to being "average" are the social scientists (86.7 percent) and physical scientists (83.3 percent). In the lower range are agriculturally (76.9 percent) and medically (69.2 percent) related scientists.

Gender

Congruent with the earlier reported findings in this chapter, men are more likely than women to have ties with foreign scientists but the magnitude of the difference is not impressive. Among the 15 women scientists, 11 (73.3 percent) have professional ties abroad to 86.1 percent of the men.

Ethnicity

There is no striking difference between two of the ethnic groups in the creating and maintaining of trans-societal networks. The Chinese (88.9 percent) and Indians (88.2 percent) are about equally involved. The percentage of Malay participation is lower (74.1 percent). Their participation being lower than the other two ethnic groups is to be expected. As we have mentioned before, the majority of Malay scientists in this study are newcomers to the world of science. Hence, they, as a category, have no legacy of traditional ties into the world of science to draw upon and are only now engaged in creating networks. Comparatively few have advanced far enough in their professional careers to have gained international recognition for their productive work as scholars.

As newcomers to higher education faculties, they predominantly have appointments to positions in the newer universities of the country. These newer institutions have yet to establish institutional networks and reputations in the scientific community either within the national society or in the wider community of world scientists. We anticipate, however, that these conditions will change in a decade or so ahead when Malay scholars have more research experience and productivity and make greater contributions in their field.

Many of the Chinese and Indian scientists have long been productive in the field. Among them are persons who have sponsored ties with foreigners and persons with well-established and recognized career reputations in their fields. Their inherited circle of influence and trans-societal interpersonal networks are now relatively larger in contrast to the Malay scientists. There is no policy or movement to impose constraints on their entry into professional roles and international networks so we do not expect proportions of these ethnic groups who participate in the third culture to diminish.

Generation

The third (85.1 percent) and fourth generations (90.9 percent) have the greater tendency to have ties with foreign scientists abroad than the two senior generations. In the first generation, 75 percent, and in the second generation, 78.6 percent are tied into overseas networks.

Highest Degree Earned

For those with only an M.B.B.S. (a medical degree), two-thirds (66.7 percent) are involved in networks abroad. For those with a masters degree in any of the sciences, the rate of involvement is high, 80 percent. Among the 47 with doctorates, 42 (89.4 percent) are involved in third cultural networks.

Of the four medical scientists who have no ties abroad, one is a dean of faculty, another is a chairman of a department, and two are women scientists who belong to the younger generation and are new in the specialty.

Looking at the four with masters degrees who have no foreign ties, one is a dean of a faculty in one of the newer universities, three are chairmen of departments--two in newer universities and one in the primate university. Despite their administrative functions, all four are currently engaged in research, collecting materials necessary for the writing of their doctorate theses.

Of the five with doctorate degrees and without extenstive foreign networks, three have administrative posts as dean or chairman of a department and two have become inactive senior scientists who both regard their scientific roles purely as an occupation and are no longer interested in having third cultural ties.

Non-participation in foreign networks is not necessarily influenced by the type of highest degree earned by scientists.

Country of Highest Education

The place of advanced education is not a major determinant of participation in third cultural ties and networks. If we inspect the ten sample scientists who have taken their highest degrees inside Malaysia, nine of them have ties abroad. Of these nine scientists, six have had all their academic training solely inside the country whereas two earned the bachelors and masters degrees in Australia and two earned their bachelors and masters degrees in Great Britain and India, respectively. Those who received their advanced degrees from the United States have slightly lower third cultural networks but many are of the most recently returned to Malaysia.

University Affiliation

Among the 51 sample scientists in the primate university, 44 (86.3 percent) have and 7 (13.7 percent) are at the present time without foreign ties. Out of the 29 respondents in the newer universities, 79.3 percent are participants and 20.7 percent are non-participants in the third culture of science.

Thus there is modest indication that there are fewer isolates from world networks in the primate university than in the newer universities. It is impressive that in the newer universities, despite the necessary involvement in institution-building, curriculum development and creating new research programs, there do exist supporting systems which encourage participation by such a high proportion (79.3 percent) of the scientists in the worldwide networks.

With this simple summary of the individuals who have network ties in foreign lands, we can analyze three major types of participation in these networks.

Three Types of Trans-Societal Interpersonal Networks

In sorting out the complex web of interpersonal ties which exist between Malaysian scientists and their foreign counterparts who are located abroad, the categories extensive, intensive and slim scientific networks are useful (McCarthy, 1972). They separate those, at the time of our study, who have broad and relatively widepsread sets of networks, those who have ones of a more narrow and intensified nature and those with thin ties which are less binding and active.

Extensive Networks

A profile of the sample of Malaysian scientists with extensive third cultural networks reveals that they usually are persons who seem to have commanding knowledge of their field, and are the leading representatives within Malaysia of the worldwide scientific community in their field. Their daily conversations often touch on the latest problems and issues of interest in their specialty and, to some degree, in science and technology in general. They are nationally and often internationally recognized scientists. They can be described in Polanyi's terms as the "chief influentials"

--those persons who are likely to influence the direction of scientific research by controlling appointments, promotions and the distribution of special subsidies and awards (Polanyi, 1967: 55-66).

They are active scientists with established reputations in their own disciplines, who devote much of their time not only interacting with specialists in their fields but also specialists in adjacent fields. Their prestige in Malaysian scientific circles is sufficiently authentic for them to appear as experts to non-specialists. Nearly all of them have records of having made contributions to their own field. They do lots of traveling to attend science meetings abroad, to teach as exchange scholars or to serve as guest speakers at a series of institutions abroad. They typically are members and fellows of foreign scientific societies in their specialities and have given papers over the years at their annual conferences. They often exchange reprints and pre-prints with their "significant others" in the same specialty. Their continuous communications with colleagues are primary sources of information for keeping up to date. They feel that they are "insiders" about what is being worked on in their field and who is working on these projects. Scientists with extensive international ties have recurrent encounters with a wide assortment of individuals within the Malaysian scientific community. Oftentimes, they assume the role of "broker." This may consist of securing admissions for their best students in foreign universities or helping arrange an institutional program between their home university and a foreign foundation. The norms which govern these relationships derive from those found among highly mobile people who know or know about each other before they meet and hence can move swiftly into "shop talk." Knowledge about personal dimensions, e.g., marital status, number of children, etc., is not so much ignored as respected, used to make realistic judgments concerning what can be expected in the "business" at hand.

Intensive Networks

Intensive networks are highly personalized professional relationships with one or a few scientists in foreign countries. In contrast to the types of relationships which take place in extensive ties in which the individual interacts with many others but only in narrowly defined segments of the total persons, intensive relationships are with fewer persons but encompass more of the totality of each of the individuals involved.

Persons involved in intensive ties may share in common not only a field but also a long history of being together in various places and times and a sense of friendship even while engaged in talking about the shared scientific interests. In addition, there often is involvement of families and parts of the "private selves." Although they are multi-bonded relationships, the degrees of access to each other and the norms of reciprocity in these personalized professional relationships depend on both the character of a particular binational third culture and the specific individuals involved. Sustaining contact with close colleagues abroad helps them to remain "scientifically alive," to feel a part of a larger collectivity in the world, and to authenticate what they value in their role in life.

Slim Networks

Slim networks refer to more peripheral and often protean relationships which Malaysian scientists have for a variety of reasons. Among our sample scientists who have slim networks, we discovered some cases in which one of the following is evident: (1) the Malaysian scientists have just begun their scientific careers or are entering into a new field of research; (2) they are no longer central in their field; (3) changes in national policy or international relationships impede the maintenance of or growth of either extensive or intensive ties.

Earlier we reported that four-fifths of the sample have ties with scientists in foreign countries. To this generalization we can now add that among those with trans-societal ties, 23.8 percent have extensive, 8.8 percent have intensive, and 51.2 percent have slim ties as can be seen in Table 58.

We now proceed to inspect the nature of the variance with respect to extensive, intensive and slim ties.

Area of Science

The two fields most actively involved in extensive networks are the life-general (42.8 percent) and the medical (30.8 percent) sciences. These two fields are the more established and institutionalized disciplines inside Malaysia. They have long been developed under the aegis of both the Malaysian government and with

TABLE 58.--Distribution of Malaysian Scientific Community Sample by Gender, Ethnicity, Area of Science, Generation and Types of Third Cultural Networks.

Characteristic of Sample	Total Sample		Type of Network: Extensive		Intensive		Slim		None	
	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	19	23.8	7	8.8	41	51.2	13	16.2
Gender										
Male	65	100.0	16	24.6	6	9.2	34	52.3	9	13.8
Female	15	100.0	3	20.0	1	6.6	7	46.7	4	26.7
Ethnicity										
Malay	27	100.0	5	18.5	0	0.0	15	55.6	7	25.9
Chinese	36	100.0	11	30.5	5	13.9	16	44.4	4	11.1
Indian	17	100.0	3	17.6	2	11.8	10	58.8	2	11.8
Area of Science										
Physical	12	100.0	3	25.0	1	8.3	6	50.0	2	16.7
Engineering	13	100.0	1	7.7	1	7.7	10	76.9	1	7.7
Life-Gen.	14	100.0	6	42.8	2	14.3	5	35.7	1	7.1
Life-Agr.	13	100.0	3	23.1	0	0.0	7	53.8	3	23.1
Life-Med.	13	100.0	4	30.8	1	7.6	4	30.8	4	30.8
Soc. Sci.	15	100.0	2	13.3	2	13.3	9	60.0	2	13.3
Generation										
First	8	100.0	3	37.5	0	0.0	3	37.5	2	25.0
Second	14	100.0	5	35.7	4	28.6	2	14.3	3	21.4
Third	47	100.0	10	21.3	3	6.4	27	57.4	7	14.9
Fourth	11	100.0	1	9.1	0	0.0	9	81.8	1	9.1

foreign assistance, mainly the British. The external assistance which has evolved over a long period of time includes financial aid, research development programs, exchange of scholars and contribution of technical facilities. Consequently, these joint efforts have resulted in the building of a strong, well-educated and competent group of Malaysian scientists in the life-general and medically related scientists. Internationally, their networks seem more firm and stable. This is evidenced in part by their having comparatively low rates of slim ties: life-general (35.7 percent) and medical (30.8 percent). All the other fields have rates of slim ties that amount to half to three-quarters of their total number of interpersonal ties.

Slim ties run high among the physical (50 percent), engineering (76.9 percent), agricultural (53.8 percent) and social sciences (60 percent). As previously noted, these sciences are not as well established and institutionalized as the other sciences, hence their pattern of networks abroad are often uncrystallized. Another factor, probably, is that most of these populations in the scientific community of Malaysia are relatively young scientists whose research work has yet to achieve recognition by scientists both inside and outside the country. Most of them are the third and fourth generation of scholars. Their studies are less often cited in the science citation index and therefore have yet to contribute a great deal to world science (see Chapter III). There are exceptions, as, for instance, the three physical scientists and one engineering scientist who have extensive interpersonal networks abroad. Included among the three physical scientists are a chemist whose specialty is "natural products chemistry," a physicist specializing in "plasma physics," and a physical geographer specializing in "applied hydrology." The lone engineer specializes in electrical engineering. All four are well-known scientists and each has a variety of ties with scientists in Great Britain, United States, Europe, Australia, New Zealand, Canada, and Southeast Asia. Hence, the nature of their individual work in critically important problem areas of their disciplines in Malaysia have encouraged extensive networks of communictions and interactions with other scientists working on similar issues in other parts of the world.

The high involvement of social scientists in the slim interpersonal networks abroad may also be due to some of them being in less established and institutionalized disciplines inside the country. With the exception of economics and geography, the disciplines of sociology, anthropology, psychology, political science and communication were introduced less than a decade ago as major university teaching subjects.

Gender

Almost twice as many women (26.7 percent) as men (13.8 percent) have no foreign networks. Subdivided by network type, the aggregate of men have a slight edge over the women in all three types of relationships. Overriding all of these trends are the cases of the three eminent women scientists who excel in their fields and participate as much as their male peers in all types of third cultural networks.

Ethnicity

A preceding section contains the information that the Chinese have a larger proportion of their numbers with personal ties to scientists in foreign countries, followed by the Indians and then the Malays in our sample. Not unexpectedly, the relative numbers who have extensive networks are higher for the Chinese (30.5 percent) than for Malays (18.5 percent) and Indians (17.6 percent). The Malaysian Chinese have been the more active scientists, the more productive researchers inside the country. Some have records of distinguished accomplishments. Much of their work has been cited by other scientists in other parts of the world. For instance, 58.3 percent of the Chinese have citations as compared to 35.3 percent Indians and 14.8 percent Malays (see Chapter III).

Malay scientists do not have intensive networks, but the proportion of Chinese and Indians who have intensive ties occurs at roughly about the same rate; 5 out of 36 Chinese (13.9 percent) and 2 out of 17 Indians (11.8 percent). These scientists are typically in highly specialized fields that are well developed in Western nations but are marginal in Malaysia. They are primarily "one of a kind" in Malaysia without adequate support systems. Thus, continuous linkage with someone of the same kind abroad is crucial for their identity as scholars. The rate of slim ties among Malay and Indian scientists is nearly even (55.6 and 58.8 percent, respectively), while fewer Chinese have slim ties (44.4 percent).

Generation

The more eminent senior generation scientists with substantial scientific achievement or a high-ranking academic position are more likely to have extensive foreign ties than the less established and younger generation of scientists. To take just the generation variable: 37.5 percent of the first or oldest generation, 35.7 percent of the second generation, 21.3 percent of the third generation and only 9.1 percent of the fourth generation have extensive ties with foreign scholars.

Slim ties are more likely among the younger generation and less eminent scientists. Thus 57.4 percent of the third generation, 81.8 percent of the fourth generation have slim ties, whereas 37.5 percent of the first and 14.3 percent of the second generation have slim ties.

Intensive ties occurring in the second and third generations and not at all in the first and fourth generations, we can speculate reflects the establishing of extensive relations among scholars at mid-career and the not yet established relations of the young.

Thus, it seems evident that one of the critical factors determining the character of participation in extensive, intensive and slim third cultural networks is generation. On a case-by-case study we find that many of the scientists with extensive ties abroad are some of the most distinguished and well-known Malaysian scientists who presently are active either as researchers or administrators. In either capacity they are identifiable leaders and often serve as scientific models for the younger generation. A great many of them exhibit special intellectual and personal skills that seem to explain their unique positions within the scientific community. Oftentimes, they appear to be highly motivated "talking gatekeepers"--individuals with both the desire and ability to circulate easily among interested colleagues and students within their institutions, the scientific community in the country and with foreigners in Malaysia and abroad.

Those with slim ties are usually of two contrasting types of persons. One type consists of young scientists who are professionals, competent, already productive to some degree and have gained a reputation of being "promising" in the scientific community. Another type consists of the less active scientists of any generation for whom science is more an occupation than a profession. Their circles of interaction and influence are sparse; their efforts and concern for scholarly achievement and their inner convictions about the importance of advancing and knowledge are appreciably low. For them, slim networks suffice.

Highest Degree Earned

Table 59 presents the highest degree earned, country of highest education and university affiliation of scientists in our sample and their types of third cultural networks.

TABLE 59.--Distribution of Malaysian Scientific Community Sample by Highest Degree Earned, Country of Highest Education, University Affiliation and Types of Third Cultural Networks.

Characteristic of Sample	Total Sample		Type of Networks: Extensive		Intensive		Slim		None	
	N	%	N	%	N	%	N	%	N	%
Total	80	100.0	19	23.8	7	8.8	41	51.2	13	16.2
Highest Degree Earned										
Bachelor	1	100.0	0	0.0	0	0.0	1		0	0.0
M.B.B.S.	12	100.0	3	25.0	1	8.3	4	33.3	4	33.3
Master	20	100.0	0	0.0	1	5.0	15	75.0	4	20.0
Doctorate	47	100.0	16	34.0	5	10.6	21	44.7	5	10.6
Country of Highest Education										
Malaysia	10	100.0	2	20.0	0	0.0	7	70.0	1	10.0
Philippines	1	100.0	0	0.0	0	0.0	1		0	0.0
India	1	100.0	0	0.0	0	0.0	0	0.0	1	
Australia/New Zealand	14	100.0	3	21.4	1	7.1	8	57.1	2	14.3
Canada	6	100.0	3	50.0	0	0.0	2	33.3	1	16.7
United States	9	100.0	3	33.3	0	0.0	4	44.4	2	22.2
Great Britain	39	100.0	8	20.5	6	15.4	19	48.7	6	15.4
University Affiliation										
Primate university	51	100.0	14	27.5	7	13.7	23	45.1	7	13.7
Newer universities	29	100.0	5	17.2	0	0.0	18	62.1	6	20.7

There is a correlation between levels of advanced education and degree of engagement in cross-national networks. Two in three with an M.B.B.S. (66.6 percent), eight in ten with a masters (80 percent) and nine in ten with a doctorate (89.3 percent) have international ties. Further, when we combine the two more powerful networks, extensive and intensive, we get 33.3 percent with an M.B.B.S., 5 percent with a masters, and 44.6 of the doctorates have strong foreign ties.

Scientists who have masters degrees are more likely to have slim ties rather then extensive or intensive ties. For instance, no scientist in our sample with a masters has extensive ties abroad and only one with a masters degree has intensive ties with his foreign counterparts. This particular scientist is presently specializing in a field which has yet to make a major impact and to recieve wider recognition in the country. He is "one of a kind," with poor supporting systems to develop his discipline, e.g., research grants, laboratory facilities and the presence of a critical mass of other scientists inside the country for scholarly discussion and dialogue. To stay scientifically alive, he has no alternative but to communicate with scientists in his field abroad.

To summarize, advanced education on the doctorate level is one of the most important dimensions in the patterning of Malaysian scientists' international networks.

Country of Highest Education

Sixty percent of the sample reached their highest education level in either Great Britain or America. Though Malaysians with British or American advanced education have similar rates of extensive/intensive networks combined, there are revealing contrasts. The British-trained are stronger in intensive networking: 15.4 percent of them have intensive interpersonal professional ties, and we could not classify any of the American-trained in our sample as having these types of relationships. The American-trained are stronger in extensive. Thirty-three percent of them have extensive types of ties whereas 21 percent of the British-trained have this type. These findings are consonant with an earlier comparative study of the British- and American-educated Indians (Useem & Useem, 1955).

A comparison of the three categories of networks offers some additional insights. First, as between scientists with either extensive or slim ties and those with intensive ties, the latter are all foreign-educated in Great Britain or Australia. Second, the geographical distribution of the countries in the former of the two categories is more dispersed around the world but still, save for one case, within the confines of the advanced Western industrial countries. Third, a detailed case-by-case review shows that for those having intensive networks abroad, foreign-Western education is one of the decisive factors influencing the creation and maintenance of their third cultural ties. Those having extensive ties need not necessarily have recieved their highest degrees abroad. Fourth, if we look carefully at those receiving their highest degrees in Malaysia, we find that the two Malaysian-educated scientists who have extensive networks around the world are among the two most active and productive scientists in the country in their particular disciplines. Anyone coming from abroad or, for that matter, from inside the country seeking knowledge about issues related to tropical disease and about Malaysian plants, orchids, birds, mammals and other biological specimens would have to contact one of these two scientists. Given the fact that the content of their work is unique because of the locality and of the quality of their performance as researchers, the place of their highest education has not been a major factor in their forging cross-cultural professional relationships. They presently are active and productive researchers in their field, their work remains relevant to world science, and the prediction is that they will continue receiving recognition from foreign colleagues and will maintain enduring third cultural ties.

University Affiliation

A somewhat larger margin of the primate university research scientists (86.3 percent) than the four newer universities (79.3 percent) have foreign networks. The primate university also has a greater proportion of its scientists with extensive and intensive networks than any of the other newer universities. Of the total 51 scientists at the primate university, 27.5 percent have extensive and 13.7 percent have intensive networks. For the total of

29 scientists at the newer universities, 17.2 percent have extensive and none has intensive networks. The newer institutions have 62.1 percent with slim ties while the primate has but 45.1 percent with slim ties.

There are a number of factors that contribute to these differences. Foremost is the history of the development of interpersonal networks among scientists; most of them are the result of individual activities. They are not routinely programed, socially inherited or ascribed by someone in authority. Although an advanced education in foreign institutions is important, it is not necessarily an automatic instrument which invariably makes for the creation and maintenance of interpersonal third cultural networks. Consider, for instance, the case of the 12 scientists, or 15 percent of our sample, who took their advanced degrees abroad but have not had any third cultural networks since their return to Malaysia. Again, it is relevant to recall that inter-insitutional cooperative projects between Malaysian and foreign universities have occurred but they have not been dominant in the professional lives of our sample.

The greater tendency for scientists in the primate university to create and maintain extensive and intensive networks abroad (41.2 percent), in contrast to their associates in the newer universities who have only 17.2 percent in these categories, can be explained by referring to several interrelated factors. First, the primate university is the oldest and most prestigious academic center of science within the national society. Several generations of scientists have been involved in productive work in this multiversity. Furthermore, it has established several well-developed linkages with selective parts of the national government and other institutions both inside the country and abroad (e.g., international agencies, foreign private foundations and foreign governments). It has received a relatively large grant in financial aid and technical support for its development projects, research, and professional training programs. It has scientific facilities (e.g., libraries, equipment, materials, office space, laboratories and specimens) superior to those in the newer universities. In addition, the scientific work produced in this institution commands more attention and carries more weight than work produced in the newer universities.

All these factors added together have contributed to the creation of a scholarly atmosphere and an academic community of research scholars. It is a well-known institution where foreign scholars often come for a visit in Malaysia. All these provide an ethos and the opportunities to establish and sustain interpersonal relationships with fellow scientists abroad.

In contrast, the newer universities on most of these scores are less established. They are currently more burdened with the forming of departments, building curriculum, and hiring and training faculties and staff. Being recently created institutions, available resources, materials, laboratory facilities and equipment are less adequate. Scientific research output in many disciplines is less substantial as compared to the research output of the primate institution. They have fewer linkages with national agencies and foreign organizations. The scientists, many from the younger generations, in these institutions have the multi-pressures of creating their own academic and research roles and figuring out how to fashion mutually useful networks within the national society and in the world scientific community.

How Malaysian Scientists Envision Their Own Professional Roles

One of the dominant themes in the current literature about the expected roles of scientists in the less-developed societies centers on their collective responsibilities and priorities in the modernization and development of their society. Many, including national policymakers, foreign consultants and "science statesmen," argue that scientists in less-developed countries should work primarily on practical and applied scientific research problems that will be directly useful and have immediate application to the needs of different sectors of the country. Re-stated, it is claimed that the less-developed countries with poorly developed science infrastructures and economic resources cannot afford to engage in fundamental research. The advanced industrial countries with their highly sophisticated "big science" establishments, wealth and expensive technology, can carry out the task of fundamental research. Others have argued that any independent society moving toward "self-sufficiency" in science and appropriate technology needs to build a core group of basic-oriented scientists within the national society in order to avoid the neo-colonialism which stems from over-dependency on foreign scientists and their epicenters for the conduct of basic research. We can argue, however, that to ensure the novel growth of a scientific community in a developing nation requires a combination of both basic and applied scientists. A balanced scientific community is needed to develop a modern culture in a society; intellectual enrichment cannot be simply borrowed from another society. What comes from the outside must be acculturated to fit indigenous patterns. The universities of a nation require basic science scholars as an integral and vital part of their instructional staff in order to make intellectual contributions to the total society.

However, viewed in the context of the knowledge base of a less-developed society, the distinction between fundamental and applied science is not as neat and convincing as those often-expressed arguments imply when matched with what working scientists regard as basic and/or practical in their fields of specialization and their own experiences in the creation and diffusion of knowledge. Instead, if we examine more closely the whole question relating to the behavior of scientists and the end users of scientific knowledge, language of thought and technology, we come across more complex issues that confuse the sharp distinction between fundamental and practical science.

Herein we analyze just one critical facet of this complex issue: how the sample of Malaysian academic scientists at work interpret the value of their own scientific roles in society. We asked each one of them to rank order from "closest to my interests" to "furthest from my interests" whom they would like their knowledge to benefit. We purposely delimited alternatives so that they were tied to current arguments on the "proper" functions of scientists in a less-developed society in the wider context of the international community. Following are the statements which they were asked to rank order:

___ I want to build knowledge which will benefit a SPECIFIC GROUP (e.g., ethnic, region, etc.).
Specify____
___ I want to build knowledge which will benefit MALAYSIA AS A WHOLE.
___ I want to build knowledge which will benefit SOUTHEAST ASIAN PEOPLE.
___ I want to build knowledge which will benefit MANKIND AS A WHOLE.
___ I want to SEARCH FOR TRUTH in my field, no matter who benefits.

Table 60 summarizes several major clusterings of their rankings as to their interest in the building of and contributing to knowledge.

One group consists of scientists whose greatest interest lies in building knowledge which would benefit Malaysia as a whole. Of the total sample, close to two-thirds (62.5 percent) ranked this either first or second in their scale of values. The social scientists emerge as the most distinctive group in that so many of them clearly aspire to have their knowledge benefit Malaysia (86.7 percent). Following them were life-medical (69.2 percent), the life-general (64.3 percent) and life-agriculture (61.2 percent). Fewer of the physical (50 percent) and engineering (38.5 percent) scientists express strong interest in having their knowledge be of benefit to Malaysia as a whole.

The second modality formed around the "search for truth no matter who benefits." Over half (55 percent) ranked this either

TABLE 60.--Distribution of Scientists' First and Second Priorities in Their Scale of Values in Terms of Contributing Their Knowledge by Area of Science and by Types of Research in Which They Are Involved.

Area of Science and Types of Research	Total Sample		Contribution of Knowledge to Whom: Specific Group		Malaysia as a Whole		S.E. Asian People		Mankind as a Whole		To Search for Truth	
	N	%	N	%	N	%	N	%	N	%	N	%
Total	80	100.0[a]	11	13.8	50	62.5	19	23.8	35	43.8	44	55.0
Area of Science												
Physical	12	100.0	1	8.3	6	50.0	0	0.0	8	66.7	8	66.7
Engineering	13	100.0	1	7.7	5	38.5	1	7.7	9	69.2	10	76.9
Life-Gen.	14	100.0	2	14.3	9	64.3	4	28.6	5	35.7	8	57.1
Life-Agr.	13	100.0	2	15.4	8	61.5	4	30.8	6	46.2	6	46.2
Life-Med.	13	100.0	3	23.1	9	69.2	3	23.1	6	46.2	5	38.5
Soc. Sci.	15	100.0	2	13.3	13	86.7	7	46.7	1	6.7	7	46.7
Types of Research												
Basic	33	41.2	4	36.4	21	42.0	8	42.1	16	45.7	19	43.2
Applied	47	58.8	7	63.6	29	58.0	11	57.9	19	54.3	25	56.8

[a]Percentages do not add to 100.0 percent since scientists have more than one priority in their scale of values in contributing their knowledge.

first or second in their priorities. About three out of four of the engineering scientists (76.9 percent) and two out of three physical scientists (66.7 percent) were in this category, and just below them were the general life scientists (57.1 percent). The social, agricultural and medically related scientists were less concerned about "seeking the truth no matter who benefits" in terms of the creating and using of knowledge. Scientists whose first priority is "the search for truth no matter who benefits" often ranked next in their scale of values "knowledge which will benefit mankind as a whole." Altogether, 43 percent did so with more than half of the engineers, approximately a fourth of the general life scientists and medically related scientists indicated this their second priority.

The building of knowledge that would "benefit mankind as a whole" is the third modality. A little less than half of the sample (44 percent) envisioned this role as being first or second in their scale of values. For the engineering (69.2 percent) and physical (66.7 percent) scientists, these are classed as their highest or second highest values. That is, more than two out of three engineering and physical scientists clearly envisioned their work role as that of creating and disseminating knowledge that might prove worthwhile around the world. The life-scientists (35.7 percent) and especially the social scientists (6.7 percent) were the least hopeful about their creating knowledge of benefit for mankind as a whole; hence, relatively few of them rank this in the top two levels of their value scale.

Another potential modality concerns the interest of creating knowledge that might benefit the peoples of Southeast Asia. We listed this item because of the growing interest in regional cooperation in this part of the world. No scientist in our sample envisioned such a contribution as their first priority. However, almost a fourth (23.8 percent) rated the role of creating knowledge for the benefit of Southeast Asian people as their second priority. Upwards of one-half of the social scientists (46.7 percent) and over a fourth of the life scientists (28 percent) made this their second priority. Furthermore, a majority of those who ranked their role as a contributor of knowledge to Malaysia first or second ranked benefiting Southeast Asian people second or third in their circle of values.

There is a small segment (13.8 percent) whose first or second priorities are building knowledge that would likely benefit a specific group and they evince little interest in contributing knowledge which might benefit any larger collectivity--Malaysia, Southeast Asia, Mankind, or Search for Truth. Seven are life scientists (two general, two agricultural and three medical), two are social scientists, and the remaining two are in the physical and engineering sciences. Of these eleven scientists, six are Malays and five are Chinese and none is Indian. Nine of the eleven belong to the newer generation.

It is illuminating to note the specific groups to which they aspire to contribute their knowledge. All of them, irrespective of their ethnic identity or generation, record their primary interests as the creating and contributing knowledge that might benefit the rural peoples. The knowledge bases which these scientists want to reconstruct are related either to health delivery systems, e.g., childbirth, maternal care, family health, food and nutrition, or agricultural production and marketing or structural changes and social acceptance of innovations among rural communities.

Besides making comparison between scientists in their own self-perceptions of where they would like to contribute their knowledge, we were also looking at the difference between scientists who classify themselves as being more in basic research or applied research, to discuss their priorities in the contributions of their knowledge.

We found that with the possible exceptions of those who wanted to make a contribution to a specific group, the proportion who classify themselves as doing basic or applied research does not differ overwhelmingly from one to another type of value statement. Among the sample scientists who envisioned their role as primarily building knowledge which would benefit Malaysia as a whole were 42 percent of those in basic research and 58 percent in applied research. If our classification scheme is valid, the results make it clear that there is no overwhelming difference between them in terms of first and second value priorities in their contribution to knowledge.

In terms of the "search for truth in my field, no matter who benefits," more than one-half of the applied, research-oriented scientists envisioned this to be their role and a slightly lower proportion of the basic-oriented scientists (43.2 percent) make this their first or second preferences. Similarly, more than half of the scientists in applied research (54.3 percent) envisioned their knowledge as contributing to the benefit of mankind as a whole, while less, but not greatly fewer, of those in basic research (45.7 percent) are apt to have this end in view.

In reviewing our findings for our sample of scientists' own role-related values as to their potential contribution (from closest to my interests to furthest from my interests) within the context of their proper functions in developing societies and in the wider contact of the world community of scientists, it is evident that there are two dominant categories. First, there is a category of scientists who feel motivated to contribute knowledge which might benefit their own society and country first, Southeast Asian people second, and mankind as a whole third. This is especially common in the life and social sciences but less so in the physical and engineering sciences. Second, there is a category of individuals whose primary interest is either in the "search for truth in my field, no matter who benefits," or that of creating knowledge which might "benefit mankind as a whole." Unlike the former category, these are the values which more strongly appeal to physical and engineering scientists and, to a lesser degree, some of the life scientists. Thus, in regard to Malaysian scientists' values in creating and sharing their knowledge, more of the social and many of the life scientists are nationally and regionally focused. More of the physical and engineering scientists and some of the life scientists are universally oriented. With poor supporting systems of their knowledge bases inside the country, both from the public and private sector, it is not unexpected, therefore, that many scientists in the physical and engineering sciences are looking outside their country for contributing their knowledge and support for scientific endeavor. In contrast, the social sciences, particularly the disciplines of economics and life sciences, have generally been conventional fields of science in the country with better developed supporting systems than engineering and physical sciences. The physical and engineering sciences are just now beginning to be seriously thought of as important fields of knowledge that can contribute to the development of the country. Thus it will be some years ahead before the physical and engineering scientists can provide "major" functions in national development.

The Third Culture of the Scientific Community

So far, the content of the chapter has consisted of the classification, enumeration, and interpretation of the conditions which have influenced our sample's trans-societal roles and networkings. In the concluding section we attempt to present a cultural perspective on the groups of scientists and their social structures from the vantage point of the interaction between the scientific community of a society and the world system of science. Our search for understanding of the part we empirically studied of a complex third culture invites further reflection on at least three domains: (1) the changing legacy of the scientific community from the viewpoint of the history of the present, (2) the underlying function of the web of global networks as these enter into the lives of working scholars, (3) an initial formalization of the shared values of the Malaysian scientific community's third culture.

History of the Present

The pattern of the growth of modern scientific organizations and scientific population were shared, by and large, by the interests of the British-Malaysian colonial state. Most of the educational and scientific institutions during the colonial period were directly created by the colonial government but, whatever their origins, they were incoporated into the state system. Nonetheless, the British generally made few efforts to introduce Western science on a broad scale during the early period of their control, even after there had been substantial development of science on the European continent. Modern science on a limited scale was not established until the beginning years of the present century. The British were the first generation of scientists in the country. However, in the ensuing years of their colonial rule they made it possible for a small but growing number of Chinese, Indians and, to a lesser extent, Malays to secure higher education in the sciences, humanities and law either in the recently formed home university (University of Malaya) or a foreign education primarily in the universities of Great Britain and moderately in the commonwealth countries of Australia and New Zealand. The first and second generations of scientists in this study were predominantly Chinese and Indians and almost entirely male and reflect colonial policies in selecting for this early program of advanced education.

Subsequently, the newly trained scientists entered the emerging professions and the administration of the colonial government as doctors, legal officers and middle-level administrators and into the academic institutions as instructors. They are exemplified by the senior generations of scientists in our study. The newly created small class of modern-educated and Western-oriented Chinese, Indian and Malay scientists subsequently served as intermediaries between the colonial state and the highly differentiated society of Malaysia. The elite community of scientists which was earlier exclusively manned by the British was now slowly yet increasingly joined by the Chinese, Indians and still later by Malays. It thereby became a complex structure in the composition of the community of scientists during the final years of the colonial period and it continued into the post-independent period. The local scientific community remained an integral part of the larger colonial system in which the sources of new knowledge and technology which carried the greatest credibility were foreign and the amount of useful knowledge easily and cheaply available to the great masses of the colonial people was scanty. Despite the creating and immediate uses of the new knowledge in the early development of public health and agriculture in the country, science did not become a major public instrument for the development of the economic and social sectors of the country outside those of direct concern to the dominant country. The state was finely tuned to law and order and the selective development of the economic sector of interest to foreigners. Furthermore, although some of the research in the medical and general life sciences contributed to the total fund of human knowledge and although the accomplishments of the few individual foreigners earned for them a world reputation, the local scientific community remained a suborindate part of the larger colonial system. Malaysian sciences and the scientific community were heavily dependent on their colonial state and its values for the definition of worthwhile intellectual scientific activities and for tangible support.

During the final years of the colonial period there developed a small nucleus of senior Malaysian scholars both in the governmental units and academic institutions in the country (especially in the fields of medical science, life-general sciences and social sciences). In the aftermath of independence, most of these scientists became influential leaders in the further development of a scientific community. They perform important roles not only in the expansion of research and development in the country but also in the scientific and technical training of the younger generations of people for future academic-based scientific work roles. These senior scientists are categorized in our study sample as the first and second generations. On the eve of the country's independence in 1957 there was no future-oriented science policy. There existed a moderately established group of scientists in a limited set of fields who were engaged mainly in natural resources assessment and surveys in the government departments and in the university.

After independence, the polity of Malaysia radically changed. To transcend a colonial heritage of accepted massive poverty, a dual economy and a narrowly external-oriented trade system, the major objective of the new country's leadership now is to bring about the economic and social transformation of all groups in society through, among other innovations, the rapid growth of higher educational institutions and research centers, and the training of scholars. These were to help the introduction of plans and implementing organizations and all the rest of the programs and projects which go with the development of the political economy and the cultural integration of a sharply differentiated class system compounded by ethnic cleavages in an underdeveloped, newly independent society. More institutions of higher education were established in the country. Thousands of Malaysians have studied abroad to secure a scientific education (at the undergraduate, graduate and post-graduate levels) that is ultimately related to modern scientific knowledge. Although Great Britain continues to be the primary country for a foreign education, there is mounting prestige among the younger generation of Malaysians in going elsewhere than England for an advanced education, e.g., United States, Australia, New Zealand, Canada, Western Europe and some Middle-Eastern countries.

The Present Functions of World Networks of Science

In Chapter I, we discussed the paradigms of a third culture of science. Briefly reviewed, then, third cultures occur in trans-societal networks; they interweave, change and develop as active scientists with similar interests come together, interact, exchange journal articles and pre-prints, share knowledge, collaborate in research, help each other in their world of work and maintain professional ties. The concept "third culture" expresses a set of relationships which arises among persons who stem from different cultures when they personally interact in their professional activities or other life patterns for a period of time in one or another place and maintain these ties by communication networks when separated.

It must also be recognized that the perceptions, reactions, the creation and maintenance of global networks by scientists in any society with scientists in other societies depends on a host of variables and also on what exists within the settings of historical colonial traditions and neo-colonial conditions, the international economic order, current domestic and foreign politics of nation states, and the growth of world systems which make for interdependence among segments of different human societies.

A third culture of science from the viewpoint of Malaysia can occur inside a society when there exists local binational or multinational networks of indigenous and foreign scholars (noted in the previous chapter) and can occur among scientists who live and work in two or more different societies but who may have interacted in either setting earlier (reported in this chapter).

In the process of building trans-societal linkages abroad, political restrictions and language barriers have selectively constrained the development of networks between the Malaysian academic scientists and their counterparts in some foreign countries such as Russia, China, Japan and in many non-English-speaking countries and in several parts of the third world. The establishment and maintenance of their third cultural networks abroad has been confined to scientists within the advanced Western industrial world and moderately with scientists in the Southeast Asian countries. African, Middle-Eastern and Latin American countries seemingly are not on the cognitive maps of Malaysian scientists. The functions a third culture performs are influenced by the nature of their binational and multinational relationships.

Given the present character of their relationships, we can then review the nature of Malaysia's dominant transactions with some of the growth centers of world science. The number of scientists increases and so, thus, the output of knowledge. The problems of storage and dissemination of knowledge become continuously larger. For research scientists, therefore, awareness of what others are doing beyond the horizon of their national society in their own specialty, in adjacent fields and in science and technology in general is important. This need can be fulfilled partially through receiving science journals and simply following the main international literature in their fields of interest.

Most rely, however, on personal cross-cultural ties to give them lead time on new problems and findings, information on international conferences, seminars and workshops as well as other information pertaining to sources of funding for research, scholarships, post-doctoral training and study abroad. In addition, participation in the third cultural networks stimulates thought and new perspectives. Talking with and listening to those stationed in foreign science centers can lead to innovative research technologies. Continuous correspondence and exchange of pre-prints and reprints, participating in international meetings and visiting with each other open avenues for meaningful intellectual dialogue between Malaysian scientists and their counterparts in foreign countries. In the process of interacting, it is also common for scientists to obtain a respected appraisal of their own research work and ideas, to get involved in an evocative intellectual exchange and to establish the basis for collaborating in further research.

It is widely recognized that scientists of the less-developed countries who reside and work in countries with less visible national scientific communities must, if they wish to make an important contribution to science and thus gain recognition in world science, conform to the standards embodied in the work being done at the science centers. They must gain access to the substance of the epicenter's accomplishments by reading its scientific literature; and they must know the language of the centers.

A third cultural network between scientific communities functions as a linkage system between scientists. An important role of Malaysian scientists with foreign ties is to help bring and acculturate the world scientific knowledge to their own society.

Science networks across cultures provide one of the bridges between scientists. What these networks and bridges mean raises questions of human identity and values.

Shared Identities and Group Values

Perhaps these dominant patterns can be discerned about the aspects of the scientific community we tried to observe. First, this is a highly self-conscious collectivity of research scholars. Unlike the continental-based scholars whose year-around work roles and interpersonal professional interaction put them regularly near or in the world epicenters of their scientific field, those ecologically distant from the centers of the world system of science are more self-conscious of their identity. To become professionalized normally implies securing a foreign education. To stay up to date usually requires constant learning about what is going on at the growing edges of world knowledge and what is being thought at the epicenters of a field. To maximize research performance often necessitates dependence on and the help of foreign counterparts.

A representative peninsular-based scientist, unless ideologically alienated from the outside world or professionally deflected into primary roles other than research, is well aware of the importance of communicating and interacting across the national boundaries. This continuing awareness of an interdependent world is matched for most with a self-conscious concern for making their own contribution to the future of their own society and country.

Second, although small in scale, this is a highly differentiated scientific community and not a self-contained, autonomous grouping of scientific scholars. Because of the history and character of the society and of the nature of the society's cross-cultural relationships around the world, the Malaysian scientific community is complexedly patterned. These are related to disciplines, ethnicity, gender, generation, highest degree earned, country of highest degree and institutional affiliation which altogether make for a highly heterogeneous national scientific community with complex third cultural networks and linkages.

Third, the particularities of the Malaysian scientific community's third cultural networks and values incorporate some of the dominant activities and aspirations of a developing Southeast Asian soceity in our times within the world system of science. They provide the social structures and cultural norms that enable Malaysian scientists to be members of both a Malaysian scientific community and of a global community of scholars.

CHAPTER VI

RESUME OF THE SCOPE AND LIMITATIONS OF THIS STUDY

This study has been a first attempt to empirically examine and interpret selective aspects of the academic-based scientific community within the context of Malaysian society and the changing interdependent world. It was designed to concentrate especially on aspects of the roles, patterns of work and third cultural networks of scientists in institutions of higher education of greater Kuala Lumpur.

The sampling frame consists of 80 published academic scientists: in the physical sciences, engineering, the life-sciences (general, medical and agricultural) and the social sciences; from three ethnic groups--Malays, Chinese and Indians; of both genders; of the younger and senior generations of scientists who have been actively engaged in research at the primate and the three newer universities of greater Kuala Lumpur. It is about a ten percent sample of the 862 academic scientists in Malaysia. The sampling procedure can be described as a disproportionate, stratified, cluster sample.

What has been left out must not be overlooked in any inferences which are drawn from the particular findings of this study.

Specifically, the sample does not include academic scientists who have not published at least one article or the equivalent. The collective roles of these omitted scholars in the academic and scientific communities and their influence on the wider Malaysian society merit examination. Also excluded were scientists in research institutes, governmental agencies and private industry in the country. Their professional careers and work-associated roles, like those of their counterparts in the institutions of higher education, are embedded in a set of complex social structures. In addition, a study of the excluded scientists in the one university in Malaysia which is located in a provincial city (University of Science) might reveal patternings different from those of academic scientists in the environs of a metropolis which is also the national capital.

In any research carried out by one person, compromises in the study design between the ideal and possible are necessary. The decision, in this instance, was to focus on individual scientists with respect to their professional identity, education, work roles, interpersonal networks with "significant colleagues" both within the immediate academic setting of their institution (usually the department) and with counterparts elsewhere in the country. Included is our sample's interaction with both Malaysian and foreign scholars who live and work in the country.

Having decided, for reasons of economy, to omit the role of teacher, the assembled data about the scientists obviously excludes an important dimension in the roles of academic scientists who typically combine teaching with research. Similarly, no effort was made to study the scientist in the role of administrator, although this status is an especially influential one in both the academic and scientific communities of a developing country.

Inasmuch as one of the central emphases of this study is on interpersonal networking, little effort could be devoted in this delimited study to the formal organization of the university as a social system and the place of the sciences in the social structure of the university system. The same restraint in scope of coverage occurs with respect to professional and scientific associations and the administration of the support systems of the scientific community.

A more comprehensive investigation could have explored the institutional, trans-societal networks which are created out of inter-organizational relationships, such as, for instance, cooperative enterprises between Malysian and foreign universities, educational exchange programs, governmental and private foundation sponsored technical assistance undertakings. While all of these joint ventures make for the formal linking of academic-based scientists of different countries, we limited the coverage of this study more narrowly to interpersonal networkings between Malaysian scientists and scientists of other countries, so as to learn the specifics of the behavior and experiences of the individual scientists. A larger study design would have included investigating the perceptions and reactions of the scientists whom the Malaysian sample identified as their "significant colleagues" in foreign countries and with whom they have extensive, intensive or slim ties. Lacking the opportunity to gather data from the foreigners, we cannot compare the differential meanings of these trans-societal, personalized relationships for the members involved.

The detailed findings of this first study of interpersonal relationships may serve to remind us of the continuing presence of the less visible social structures which are so important in the functioning of a scientific community. How these might be taken into account and sustained in future thinking about science policy in a developing country invites reflection. How these patternings of relationships might be further studied to give a surer grasp of the cultural norms and behavior challenges the imagination of those with an interest in the sociology of science.

In view of our special interest in the societal functions of persons engaged in science, selective emphasis was put on the expanding role of academic scientists as technocratic consultants in a developing society. However, we could not explore the whole range of interrelations which occur when a scientist serves as a temporary or part-time adviser to a public or private group. Instead, we could focus only on the scientists' own perceptions of that role-acting. Clearly, more in-depth studies are necessary before we can fully comprehend this type of transaction with respect to various sectors of society and in the context of a variety of issues. Since this part of the study concerns only learning about the extent and broad character of the activities of scientists in certain situations, it does not permit any interpretation about the conditions which are brought into a group and the actual impact of their role on the end users of science-derived knowledge (see Arcega, 1976).

Moreover, the present research does not trace the growing importance of the collectivity of scientists on the expanding professions and the educated middle classes of society. A more ambitious in scale undertaking would have been an assessment of the impact of the scientists-scholars on the political economy and culture of the various traditional segments of Malaysian society in a period when the central institutions of the country are deeply involved in development and modernization. One order of research has been directed by some scholars toward the processes of diffusion of knowledge and technology and the "change agents" as mediators between the knowledge centers and local communities. Others have been directed toward the influence of modern scholars on the world-view of a people in the midst of great changes in their lives. These kinds of sociological inquiry fall outside the scope of this study, except as a search for an orientation to the present relationship between science and society in Malaysia.

In the modernizing society of the third world, we recognize that the interaction between the socio-cultural heritage and the present situations are of critical importance in thinking about the growth and character of a scientific community. The reconstruction of the processes which transform a colonial third culture into a contemporary third culture in Malaysia cannot be fully achieved by interviewing scientists only. It requires more documentation from many sources. To partially understand the personal meaning of historical change among the members of the Malaysian scientific community, we use the variable generation. We realize there are weaknesses in this scheme. First, there is a demographic shortage in the relative numbers who could be included in our sampling of the pre-independence senior generation. Second, many of the younger Malaysian scientists who have only recently returned from their studies abroad are still in the formative stages of their professional careers. Third, there are historically determined constraints on the proportions of women, some fields and Malays in the senior generation who could be part of our sample. Therefore, our findings are, at best, only informative about how those who make up the present generations of scholars react. Nonetheless, this in some ways opens up the possibility of interpreting the present behaviors and values of different generations of scholars with reference to Malaysian cultural history.

In summarizing the variable of disciplinary field, our findings point to marked disparities among fields in the role-related behaviors. This study, however, was not aimed at studying the acculturation of the content of each field to the Malaysian scene, nor evaluating the quality of the research and development of the different fields, nor in any way measuring their impact on Malaysian culture and society. Within the confines of this research, several tentative generalizations might be reviewed.

Our sample data of selected indicators suggest that, at the present point in time, the life-general and medical sciences show signs of being the leading disciplinary areas in the Malaysian scientific community. Compared with groups of scientists in other fields, a higher proportion of them have been consistently more actively engaged in productive research, are more internationally cited, participate in more extensive networking with scientists in other countries, and have greater involvement in scientific conferences both within the country and abroad. In contrast, the physical and engineering sciences presently fall behind these two groups of life sciences in their development and contribution. These findings run contrary to the findings about the scientific communities of Europe and America (Hagstrom, 1965; Crane, 1972). This lag can be traced, in part, to a series of historical circumstances and to some of the conditions in the present period.

In the colonial period, because of state polity and the dual economy, the development of manufacturing industry and technological systems to meet local needs of indigenous Malaysians were not supported and this precluded the emergence in the country of a demand for scientists and technologists in the physical and engineering sciences. Accordingly, these two fields had no traditional base and in the years since independence, persons trained in the physical and engineering sciences find few opportunities for employment except in government departments, schools and colleges. The manufacturing sector which has recently grown to 16 percent of the gross domestic product consists mostly of multinational corporations. They are more accustomed to transferring foreign technologies for local use in an underdeveloped country than in innovating an indigenous technology on which they might depend. Hence, they have no incentive for fostering local research and development capacities. By all accounts, Malaysia is short a core of innovating high-level professional "craftsmen" in industry or "hard science"-educated managerial leadership and industrial entrepreneurs in the indigenous private sector. Since independence, then, the physical and engineering sciences remain less developed.

The academic agricultural and social sciences can be put in between the two polar sets of sciences. Both are relative newcomers to Malaysia's academic and scientific communities. Consequently, they have a disproportionately large percentage of younger generation scientists and correspondingly fewer senior scientists, including statesmen-scholars of eminence, to provide effective professional leadership. The agricultural sciences were not at the center of higher education in the colonial era in which the Malay masses lived as peasants in a state of agrarian poverty and technological backwardness. The post-independence drive of the national leadership to end the dual economy, confront the problem of rural poverty, and build a new socioeconomic order was institutionalized, in part, with the creation of the University of Agriculture in 1971. For this reason, academic science in agriculture still is in the early phase of its emergence. However, the indicators employed in this study reveal a nascent research and development tradition for agriculture in the country. With the exceptions of economics and geography, the social sciences are newly developed fields in the academic institutions in the country. They, therefore, are not as well established and institutionalized disciplinary fields as are the life sciences.

The conventional study of gender has been to a large extent concerned with whether or not men and women have been accorded equality. While recognizing that this is a valid issue, it is not the only issue we need to examine among male and female scholars. We have, therefore, tried in this study to broaden the content of our concern by making gender a standard independent variable. But we have not examined more than the surface of this topic. There are demographic factors connected with gender performance which the study recorded. Because of the colonial heritage which favored men's participation in the public world, the women in the sample are mostly of the younger generation of scholars and are presently less influential than the men in the Malaysian academic and scientific communities. As technocratic consultants they are more confined in scope than their male counterparts. Their third cultural networks with the "significant colleagues" abroad are more commonly slim than extensive or intensive in character. The sharp contrast between the Philippine and Malaysian scientific community on this score suggests further study not only of the Malaysian heritage but also further thinking about the prospects for the future on gender norms and opportunities as the younger generation of women scientists advance in the professional careers.

Ethnicity is a pervasive social front in multiracial Malaysia and it is directly relevant for the scientific community. However, any attempt to monitor changes in national policies and the underlying problems of ethnicity and the political economy in relationship to higher education, the delivery system of knowledge and the changing opportunities for ethnics to enter the scientific community is well beyond the scope of this study. Within the present scientific community, the Chinese and Indians are relatively "old-timers" whereas the Malays are most often "first-timers." The Chinese and Indians, proportionate to their numbers, presently are more established and productive in research than their Malay colleagues. In contrast to the Chinese and Indians who had, during the colonial period, an early entry into the sciences, most of the Malays are newcomers and, hence, part of the younger generation of scholars. Like the women, they, too, have not had an authentic place in Malaysian higher education, especially in science and technology, until long after independence and until the onset of deliberate national commitment to encourage more Malays to study in the sciences. Being newcomers, it is to be expected that their contribution to knowledge, their recognition by scientists around the world (as evidenced by citations), and their trans-national networks would lag for a time behind that of their non-Malay peers. But the impressions gained from lengthy discussions with a cross-section of the younger generation of Malay scientists about their present work and aspirations suggest an early closing of the ethnic gap in productivity and other performance standards.

In our study of generations, the indicators reveal that the social circles of the Malaysian academic-based scientific community are fairly stratified on several scores. The younger scientists have more circumscribed professional relations--usually their departmental colleagues and friends with similar professional interests within their own institutions. Most have very few professional ties into other segments of the society. The older generation, especially those who are prominent both inside the country and abroad, have more extensive professionally related ties in the country. Besides regularly interacting with the colleagues and subordinates within their own fields and institutions, they more frequently have regular contacts with professionals in industry, policymakers, foreign and international representatives of foundations and agencies inside the country. Some also have interaction with persons in the creative and performing arts. They exhibit in their day-by-day conversation more concern with events relating to societal problems, science policy, institution building, questions of national and regional interest, and world affairs. These concerns are not as often manifested among the younger scholars whose conversations with one another are more likely to center on their immediate scientific work, professional careers, income, occupational promotion and current public affairs. Whether this difference represents contrasting stages in the life cycle of professional careers or contrasting cognitive systems with a narrowing professionalization among the new generation of scientists who stem most recently from the world epicenters of science, is beyond this study's reach to conclude. Intergenerational relationships deserve closer scrutiny than was possible in this study. It could be studied in terms of the norms of hierarchy which have a bearing on the exercise of leadership and the processes of innovation in the local academic and scientific community. This is more crucial for those third world countries in which a large part of the scientific community in each generation is foreign educated than it is in those countries where the senior generation educates the following generations. The foreign-returned must find their place in a social structure that is integrated around the senior generation.

The study of the primate and newer institutions as a variable of the scientific community has not permitted us to examine in detail for comparative purposes the inner character of these institutions. All that could be achieved here was to record the gross contrasts and speculate on their sources and future prospects of continuing to be present.

Our exploration of the sample of the academic scientists' outlook on the potential contribution of their work is just a start. Even this small part should alert us to the importance of going beyond the simple categories of basic and applied to pursue the character of the interests which motivate the working scholar. We have not even opened the still bigger question of the conditions which might enable these scholars to fulfill their values.

Finally, given the small scale and heterogeneous character of the Malaysian scientific community and its geographical marginality to the primary centers of global science, and given the still fragile knowledge base in Malaysia, there probably will continue to be fundamental dependency and asymmetry in the relationships between the Malaysian scientific community and the more developed countries' scientific communities in the years ahead. We, therefore, can anticipate an increased amount of personalized third cultural networkings among scientists in the less-developed with those in the developed societies. The norms of this culture clearly needs close study. Less certain is the relationship of the Malaysian scientific community to the less-developed societies of the world. The record of interaction with scientists in other parts of Southeast Asia shows some viable relationships on a modest scale. Personal ties with fellow scientists in the Middle-East, Africa and Latin America are as yet negligible. These might become creative and important ties with the growth of a worldwide scientific community.

This study being only a beginning, it opens numerous questions which invite further study if we are to gain a surer understanding of the performance and potentialities of the Malaysian scientific community.

BIBLIOGRAPHY

BIBLIOGRAPHY

Appel, G. N.
1965 "The nature of social groupings among the Rungus Dusun of Sabah, Malaysia." Ph.D. dissertation, Australian National University, Canberra.

Apter, D.
1965 The Politics of Modernization. Chicago: University of Chicago Press.

Arcega, Victoria M.
1976 "Technocrats as middlemen and their networks in the Philippine rice project: the case of Masagana 99." Ph.D. dissertation, Michigan State University.

Arles, J. P.
1971 "Ethnic and socio-economic patterns in Malaysia." International Labour Review 104 (December):527-554.

Barber, Bernard and Walter Hirsch (eds.)
1962 The Sociology of Science. Glencoe: The Free Press.

Basalla, George
1967 "The spread of Western science." Science 156 (May 5): 611-621.

Ben-David, Joseph
1971 The Scientist's Role in Society. Englewood Cliffs, N.J.: Prentice-Hall.

Bennis, Warren G.
1956 "Values and organization in a university social research group." American Sociological Review 21:555-563.

Bernal, J. D.
1941 The Social Function of Science. New York: The Macmillan Company.

Blisset, M.
1972 Politics in Science. Boston: Little, Brown and Company.

Blume, S. S., and R. Sinclair
1973 "Chemist in British universities: a study of the reward system in science." American Sociological Review 38 (February):126-138.

Blythe, W. L.
1947 "Historical sketch of Chinese labour in Malaya." Journal of the Malayan Branch of the Royal Asiatic Society 20 (Part I):64-125.

Brown, J. D. and F. Harbison
1957 High-Talent Manpower for Science and Technology. Princeton: Princeton University Press.

Coedes, G.
1968 Indianized States of Southeast Asia. Honolulu: East-West Center Press.

Cole, J. R. and S. Cole
1973 Social Stratification in Science. Chicago: University of Chicago Press.

Coser, Lewis
1965 Men of Ideas. New York: The Free Press.

Crane, D.
1965 "Scientists at major and minor universities." American Sociological Review 30 (October):699-714.

1972 Invisible Colleges. Chicago: University of Chicago Press.

Dedijer, Stevan
1963 "Underdeveloped science in underdeveloped countries." Minerva II (1):68-81.

de Solla Price, Derek J.
1963 Little Science, Big Science. New York: Columbia University Press.

Despres, L. A.
1967 Cultural Pluralism and Nationalist Politics in British Guiana. Chicago: Rand McNally and Co.

Dupree, A.
1957 Science in the Federal Government, a History of Policies and Activities to 1940. Cambridge, Mass.: Belknap Press of Harvard University Press.

Eisenstadt, S. N.
1964 From Generation to Generation: Age Groups and Social Structure. New York: The Free Press.

Esman, Milton Jacob
1972 Administration and Development in Malaysia; Institution Building and Reform in a Plural Society. Ithaca: Cornell University Press.

Firth, J. R.
1966 Malay Fishermen: Their Peasant Economy, 2nd ed. London: Routledge and Kegan Paul. (First edition published in 1946.)

Fraser, T. M.
1960 Rusembilan: A Malay Fishing Village in Southern Thailand. Ithaca: Cornell University Press.

Freeman, J. D.
1955 Iban Agriculture. A Report on the Shifting Cultivation of Hill Rice by the Iban of Sarawak. London.

Friedson, Eliot
1970 Profession of Medicine. New York: Dodd, Mead and Co.

Furnival, J. S.
1948 Colonial Policy and Practice. London: Cambridge University Press.

Gaston, J.
1970 "The reward system in British science." American Sociological Review 35 (August):718-732.

1973 Originality and Competition in Science. Chicago and London: University of Chicago Press.

Glazer, B. G.
1963 "The local-cosmopolitan scientist." American Journal of Sociology 69:249-259.

1964 Organizational Scientists: Their Professional Careers. Indianapolis: Bobbs-Merrill Co., Inc.

Gray, John and Brian Perry
1975 Scientific Information. London: Oxford University Press.

Gruber, Ruth (ed.)
1961 Science and the New Nations. New York: Basic Books.

Gullick, J. M.
1958 Indigenous Political System of Western Malaya. London: The Athlone Press.

Hagstrom, W. D.
1965 The Scientific Community. New York: Basic Books.

Harbison, F. H. and C. A. Myers
1964 Manpower and Economic Growth. New York: McGraw Hill Book Co.

Hargens, L. and W. O. Hagstrom
1967 "Sponsored and contest mobility of American academic scientists." Sociology of Education 40 (Winter):24-38.

Heilbroner, R. L.
1974 An Inquiry Into the Human Prospect. New York: W. W. Norton and Co., Inc.

Hirschman, Charles
1975 "Ethnic and social stratification in Peninsular Malaysia." Washington: American Sociological Association Rose Monograph Series.

Hodgkin, Mary C.
1972 The Innovators: The Role of Foreign Trained Persons in Southeast Asia. Sydney: Sydney University Press.

Holton, Gerald (ed.)
1965 Science and Culture. Boston: Houghton Mifflin Co.

Hoong, Yip Yat et al. (eds.)
1973 Development Planning in Southeast Asia: Role of the University. Singapore: Regional Institute of Higher Education and Development.

Huxley, L.
1918 Life and Letters of Sir Joseph Dalton Hooker. Murray: London, Vol. 1:54-167.

Ilchman, W. F., A. S. Ilchman and D. H. Hastings
1968 The New Men of Knowledge and the Developing Nations. Planners and the Polity: A Preliminary Survey. Berkeley: Institute of Governmental Studies, University of California.

Indonesia
1970 SEAMEO. Report of the Regional Centre for Tropical Biology. Jakarta.

Jackson, R. M.
1961 Immigrant Labour and the Development of Malaya: 1786-1920. Kuala Lumpur: Government Printer, Federation of Malaya.

Joo-Jock, L., and S. B. D. Silva
1976 Southeast Asian Affairs. Singapore: Institute of Southeast Asian Studies.

Kaplan, Norman, ed.
1965 Science and Society. Chicago: Rand McNally.

Koentjaraningrat, Radin Mas
1975 Introduction to the Peoples and Cultures of Indonesia and Malaysia. Menlo Park, Calif.: Cummings Publishing Co.

Kong, Kee Poo
1976 Tertiary Students and Social Development: An Area for Direct Action Student Rural Service Activities in Malaysia. Singapore: Regional Institute of Higher Education and Development.

Kornhauser, W.
1962 Scientists in Industry. Berkeley: University of California Press.

Kuhn, Thomas
1970 The Structure of Scientific Revolutions, 2nd ed. Chicago: University of Chicago Press.

Kwok, D. W. Y.
1965 Scientism in Chinese Thought: 1900-1950. New Haven: Yale University Press.

Lehman, H. C.
1953 Age and Achievement. Princeton: Princeton University Press.

1960 "The age decrement in scientific creativity." American Psychologist 15:128-134.

Lijphart, Arend
1968 The Politics of Accommodation: Pluralism and Democracy in the Netherlands. Berkeley: University of California Press.

1969 Politics in Europe: Comparisons and Interpretations. Englewood Cliffs, N.J.: Prentice-Hall.

Malaysia
1956 First Malaya Plan 1956-1960. Kuala Lumpur: Government Printer.

1960 Second Malaya Plan 1961-1965. Kuala Lumpur: Government Printer.

1965 First Malaysia Plan 1966-1970. Kuala Lumpur: Government Printer.

Malaysia
1969 SEAMEO. Report of the Regional Centre for Education in Science and Mathematics. Penang.

1971 Second Malaysia Plan 1971-1975. Kuala Lumpur: Government Printer.

1972 Population and Housing Census of Malaysia, Community Groups, 1970.

Matejko, Alexander
1967 "The organization of stratification of scientific workers in Poland." Sociology of Education 40(1):48-56.

McCarthy, Florence E.
1972 "The third cultural networks of Philippine physical, life and social scientists." Ph.D. dissertation, Michigan State University.

Menzel, Herbert.
1962 "Planned and unplanned scientific communication." in Bernard Barber and Walter Hirsch (eds.), The Sociology of Science. Glencoe, Ill.: The Free Press.

1966 "Informal communication in science: its advantages and its formal analogues." in Dan Bergen (ed.), The Foundations of Access to Knowledge. Syracuse: Syracuse University Press.

Merton, R. K.
1971 Science, Technology and Society in Seventeenth Century England. New York: Harper Torchbooks.

1973 "The normative structure of science." in R. K. Merton, The Sociology of Science. Chicago and London: University of Chicago Press (originally published in 1942).

Milne, Robert Stephen
1967 Government and Politics in Malaysia: Boston: Houghton-Mifflin Co.

Moravesik, Michael J.
n.d. Science Development. PASITAM, Bloomington: Indiana University Press.

Mullins, N. C.
1973 Science: Some Sociological Perspectives. Indianapolis: The Bobbs-Merrill Co., Inc.

Nader, Claire and A. B. Zahlans (eds.)
1969 Science and Technology in Developing Countries. Cambridge: Cambridge University Press.

Nelson, C. E. and D. K. Pollock (eds.)
1970 Communication Among Scientists and Engineers. Lexington, Mass.: D. C. Heath and Co.

Noss, Richard
1967 "Language policy and higher education." in Higher Education and Development in Southeast Asia, Vol. III, Part 2. Paris: UNESCO and International Association of Universities.

OECD
1969 Science and Society: A New Perspective. Report of the Secretary-General's Ad Hoc Group on New Concepts of Science Policy.

Parmer, J. Norman
1960 Colonial Labour Policy and Administration. New York: Monograph of the Association for Asian Studies.

Passman, Sidney
1969 Scientific and Technological Information. London: Pergamon Press.

Pelz, D. C. and F. M. Andrews
1966 Scientists in Organizations. New York: John Wiley and Sons, Inc.

Philippines
1969 SEAMEO. Report of the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture. Laguna.

Polanyi, Michael
1967 "Life transcending physics and chemistry." Chemical and Engineering News 45(35):55-66.

Price, Don K.
1965 The Scientific Estate. Cambridge, Mass.: Harvard University Press.

Purcell, Victor
1967 The Chinese in Malaya. Kuala Lumpur: Oxford University Press (originally published in 1948).

Rabuska, A. and K. A. Shepsle
1972 Politics in Plural Societies: A Theory of Democratic Instability. Columbis, Ohio: Charles E. Merrill Publishing Co.

Ravetz, Jerome R.
1971 Scientific Knowledge and Its Social Problems. Oxford: Clarendon Press.

Restivo, Sal P.
1971 "Visiting foreign scientists at American universities: a study in the third culture of science." Ph.D. dissertation, Michigan State University.

Restivo, Sal P. and C. K. Vanderpool (eds.)
1974 Comparative Studies in Science and Society. Columbus, Ohio: Charles E. Merrill Publishing Co.

Ribeiro, Darcy
1967 "Universities and social development." in D. Ribeiro, Elites in Latin America. New York: Oxford University Press.

Richter, Maurice N., Jr.
1972 Science As a Cultural Process. Cambridge, Mass.: Schenkman Publishing Co., Inc.

Sandhu, K. S.
1969 Indians in Malaya: Some Aspects of Their Immigration and Settlement (1786-1967). Cambridge: Cambridge University Press.

Schooler, D.
1971 Science, Scientists and Public Policy. New York: The Free Press.

Shah, A. B. (ed.)
1967 Education, Scientific Policy and Developing Societies. Bombay: Manaktalas.

Shamsul Huq, Mohammad
1975 Education, Manpower and Development in South and Southeast Asia. New York: Praeger Publishers.

Shils, Edward
1961 "Science development in the new states." in Ruth Gruber (ed.), Science and the New Nations. New York: Basic Books.

1966 "Toward a national science policy." in John W. Hanson and Cole S. Brembeck (eds.), Education and the Development of Nations. New York: Holt, Rinehart and Winston.

1972 The Intellectuals and the Powers and Other Essays. Chicago: University of Chicago Press.

Singapore
1969 SEAMEO. Report of the Regional English Language Centre. Singapore.

Sinha, Surajit
1970 Science, Technology and Culture. New Delhi: India International Centre.

Snow, C. P.
1959 The Two Cultures and the Scientific Revolution. Cambridge: Cambridge University Press.

Storer, Norman W.
1966 The Social System of Science. New York: Holt, Rinehart and Winston.

Suttmeier, Richard
1974 Research and Revolution: Science Policy and Societal Change in China. Lexington, Mass.: D. C. Heath and Co.

Swift, M. G.
1965 Malay Peasant Society in Jelebu. New York: Athlone.

Tapingkae, Amnuay
1974 The Growth of Southeast Asian Universities: Expansion Versus Consolidation. Singapore: Regional Institute of Higher Education and Development.

Thailand
1968 SEAMEC. Report of the Tropical Medicine Project of SEAMEC Central Co-ordinating Board. Bangkok.

Thompson, K. W., D. R. Fogel and H. E. Danner (eds.)
1977 Higher Education and Social Change. New York: Praeger Publishers.

Turner, Ralph
1960 "Sponsored and contest mobility and the school system." American Sociological Review 25:855-867.

UNESCO
1963 Science and Technology for Development. Report on the United Nations Conference on the Application of Science and Technology for the Benefit of Less-Developed Areas.

1970 Science and Technology in Asian Development. Paris: UNESCO.

Useem, John
1971 "The study of cultures." Sociological Focus. Reprinted in Studies of Third Cultures, Number 6, Institute for International Studies in Education, Michigan State University, East Lansing.

Useem, John, John Donoghue and Ruth Hill Useem
1963 "Men in the middle of the third culture: the roles of American and non-Western people in cross-cultural administration." Human Organization 22:169-179.

Useem, John and Ruth Hill Useem.
1955 The Western-Educated Man in India. New York: Holt, Rinehart and Winston.

1967 "The interfaces of a binational third culture: a study of the American community in India." The Journal of Social Issues 23 (January):130-143.

Useem, John, Ruth Hill Useem and Florence C. McCarthy
"Linkages between the scientific communities of less-developed and developed countries: a case study of the Philippines." Honolulu: East-West Center. Forthcoming.

Vanderpool, C. K.
1971 "Visiting foreign scientists in the United States: the impact of systematic and role circumscription and dissociative experiences on the homogeneity of the international scientific community." Ph.D. dissertation, Michigan State University.

Vollmer, H. N. and D. L. Mills (eds.)
1966 Professionalization. Englewood Cliffs, N.J.: Prentice-Hall.

Wallace, A. K.
1906 My Life. New York, Dodd, Mead, Vol. 1: 337-384.

Wang, Y. C.
1966 Chinese Intellectuals and the West, 1927-1949. Chapel Hill: University of North Carolina.

Wilensky, H. L.
1964 "The professionalization of everyone?" American Journal of Sociology 60 (September):138-158.

Wilson, Mitchell
1972 Passion to Know. New York: Doubleday and Co., Inc.

Wilson, P. J.
1967 A Malay Village and Malaysia. New Haven, Conn.: Human Relations Area Files Press.

Wong, Francis H. K. and Gwee Yee Hean
1972 Perspectives: The Development of Education in Malaysia and Singapore. Kuala Lumpur: Heinemann Educational Books (Asia) Ltd.

Wong, Francis H. K. and Ee Tiang Hong
1975 Education in Malaysia, 2nd ed. Kuala Lumpur: Heinemann Educational Books (Asia) Ltd.

Ziman, J. M.
1968 Public Knowledge. Cambridge: Cambridge University Press.

Znaniecki, Florian
1965 The Social Role of the Man of Knowledge. New York: Octagon Books, Inc.

Zuckerman, Harriet
1971 "Stratification in American science." in Edward O. Laumann (ed.), Social Stratification: Research and Theory for the 1970s. Indianapolis: Bobbs-Merrill Co., Inc.

APPENDIX

APPENDIX

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF SOCIOLOGY EAST LANSING : MICHIGAN : 48824

MALAYSIAN SCIENTIFIC COMMUNITY STUDY 1/76

Researcher: Abu Hassan Othman

Local Address: Jabatan Antropologi dan Sosiologi, Universiti Kebangsaan Malaysia, Peti Surat 1124, Jalan Pantai Baru, Kuala Lumpur 22-12, Malaysia

Telephone: 54644 Extension 275

SELF–ADMINISTERED QUESTIONNAIRE

This self-administered questionnaire is divided into *SIX* sections These include:

SECTION A: GENERAL INTRODUCTION

SECTION B: RESEARCH

SECTION C: CONSULTING AND ADVISORY

SECTION D: THE NETWORKS OF SCIENTISTS WITHIN THE INSTITUTION AND WITHIN THE COUNTRY

SECTION E: THE NETWORKS OF SCIENTISTS ABROAD

SECTION F: BIO – DATA SHEET

We are indeed very grateful and appreciative of your support and cooperation to answer all questions in each section that concern you.
If you come across any question that is not clear to you please check in the margin. I will be glad to clarify it with you if you contact me at the above address or at the time when I come to pick the questionnaire.

PLEASE DO NOT WRITE YOUR NAME

Interview No:
Date Completed:

SECTION A: GENERAL INTRODUCTION

A-1 What is your field of special interest (specialization)?

....

A-2 Within what broad grouping of the sciences would you classify yourself?

1 ☐ Physical sciences
2 ☐ Engineering
3 ☐ Biological sciences
4 ☐ Agricultural sciences
5 ☐ Medical
6 ☐ Social sciences

A-3 What is your main job or position (e.g. professor, assoc. professor, lecturer etc.)

....

A-4 What is (are) your other job(s)?

1 ☐ Head of Department
2 ☐ Dean of Faculty
3 ☐ Consultant and advisor
4 ☐ Other (specify) ....

A-5 In your present position how is your time divided between research (including training students in research), instruction, administration, consulting and advising, clinical service etc. ?

1	☐	Research (including training students for research)	.... %
2	☐	Instruction including lectures, seminars, tutorials etc.	.... %
3	☐	Administration and committee services	.... %
4	☐	Consulting and advisory	.... %
5	☐	Clinical service	.... %
6	☐	Civil and political activities	.... %
7	☐	Other (specify)	.... %
			===============
		TOTAL	100%

Interview No:
Date Completed:

SECTION B: RESEARCH

R-1 In the last *THREE* years or so, what type of research have you been involved in?
IF YOU ARE NOT INVOLVED THEN SKIP TO R-10

	Subject Matter (State the most recent first)	Type of Research (Basic/Applied)	Sources of Funding (e.g. Own Inst., Govt., UNESCO,FAO,WHO,etc.)
1	....	....	....
2	....	....	....
3	....	....	....

TAKING *ONE* OF YOUR MOST RECENT RESEARCH PLEASE ANSWER QUESTIONS R-2 TO R-9

R-2 How long have you been involved with this particular research?

1 ☐ less than one year
3 ☐ more than two years
2 ☐ between one to two years

R-3 How did you happen to get involved in this particular research? Check all that apply

1 ☐ I started with it in graduate school and I am continuing with the same study
2 ☐ I am continuing with the same problem that I started in graduate school, but somewhat modifying it to fit Malaysian conditions
3 ☐ I am working on a problem that has been recommended to me by the senior scientists in our department
4 ☐ I am working on a problem that has been of direct concern to policymakers or administrators
5 ☐ I am working on a problem that has been recommended to me by the private industry
6 ☐ I have started a new line of research that fits into some of the central research concerns of my field
7 ☐ I am working on a problem that I think will be important to the future of the country
8 ☐ I pick this problem because there were funds and facilities to do this research
9 ☐ I am working on a problem that has been suggested to me by international organization (specify): ....
10 ☐ Other (specify): ....

Interview No:
Date Completed:

R-4 Who else are (were) working on the research you were doing?

CHECK CATEGORIES THAT ARE APPLICABLE

1 ☐ none

2 ☐ undergraduates

3 ☐ graduates

4 ☐ staff (specify) e.g. Lab. Assist, Technicians etc. ....

5 ☐ other department members

6 ☐ other colleagues (specify):

	Discipline	Department	Institution
a.	....	....	....
b.	....	....	....
c.	....	....	....
d.	....	....	....
e.	....	....	....

R-5 If you are (were) working with others on this research specify the leader of your research?

1 ☐ myself

2 ☐ other (specify): ....

R-6 How were the findings of this research be reported?

1 ☐ lectures   2 ☐ seminars, workshops, conferences

3 ☐ journals (specify):

  a. ☐ local   Name of journal: ....

  b. ☐ foreign   Name of journal: ....

  Country: ....

4 ☐ book (specify where published):

  a. ☐ local

  b. ☐ foreign   Country: ....

5 ☐ Monograph or reports (specify where published)

  a. ☐ local

  b. ☐ foreign   Country: ....

6 ☐ memeograph or pre-print   9 ☐ report to government organization

7 ☐ popular newspapers, magazines etc.   10 ☐ report to private industry

8 ☐ news release   11 ☐ Thesis

12 ☐ Other (specify): ....

Interview No:
Date Completed:

R-7 Who will be the author of this research report?

1 ☐ myself

2 ☐ with others

R-8 If with others will you be junior author?

1 Yes ☐ 2 No ☐

3 If Yes, who will be the senior author?

a. ☐ Malaysian

b. ☐ Foreigner

R-9 In what language will you publish this research work?

1 ☐ English

2 ☐ Bahasa Malaysia

3 ☐ Both English and Bahasa Malaysia

4 ☐ Other (specify) ....

TURNING TO MORE GENERAL QUESTION ON RESEARCH

R-10 For the period as a member of the faculty have you ever collaborated (are collaborating) with scientists in your professional field doing research?

1 Yes ☐ 2 No ☐

3 If Yes, please take the most recent case and specify:

	Name	Position/Rank	Research project
1	....	....	....
2	....	....	....
3	....	....	....
4	....	....	....
5	....	....	....

IF FOREIGNER *CIRCLE* AND INDICATE COUNTRY OR ORIGIN

Interview No:
Date Completed:

R-11 Outside your own institution have you collaborated with scientists in your professional field doing research?

1 Yes ☐ 2 No ☐

3 If Yes, please specify name and institution:

	Name	Institution
1	....	....
2	....	....
3	....	....
4	....	....
5	....	....

IF ANY OF THE ABOVE ARE FOREIGNERS *CIRCLE* AND INDICATE COUNTRY OF ORIGIN

R-12 Have the results of your research been made used by anybody?

1 Yes ☐ 2 No ☐ 3 Don't know ☐

4 If Yes, indicate what particular occupation(s) or profession(s) in Malaysia have used or have applied the findings of your research?

Name of occupation(s) or profession(s) (e.g. medical, agriculture, education etc.)

a. ....

b. ....

c. ....

d. ....

e. ....

5 If No, please briefly indicate why?

....

....

....

....

Interview No:
Date Completed:

R-13 Do you have any unit or sector in the government that has an interest in your research work?

1 Yes ☐ 2 No ☐ 3 Don't know ☐

IF NO, SKIP TO R-14

4 If Yes, has any of the unit or sector made an effort to draw you in to become acquinted with its problems?

a. Yes ☐ b. No ☐

c. If No, have you made an effort to approach the unit or sector to have it become acquinted with its problems?

a. Yes ☐ b. No ☐

R-14 Do you have any unit or sector in the local private industry/or firms that has an interest in your research work?

1 Yes ☐ 2 No ☐ 3 Don't know ☐

IF NO, SKIP TO R-15

4 If Yes, has any of the unit or sector made an effort to draw you in to become acquainted

a. Yes ☐ b. No ☐

c. If No, have you made an effort to approach the unit or sector to have it become acquainted with its problems?

i. Yes ☐ ii. No ☐

R-15 Do you have any unit or sector in the foreign private industry or firms that has interest in your research work and interests?

1. Yes ☐ 2 No ☐ 3 Don't know ☐

If No, skip to R-16

4 If Yes, has any of the unit or sector made an effort to draw you in to become acquinted with its problems?

a. Yes ☐ b, No ☐

c. If No, have you made an effort to approach the unit or sector to have it become acquainted with your research work and interests?

i. Yes ☐ ii. No ☐

R-16 How influential or prominent are researchers in your professional field inside Malaysia and outside Malaysia?

	Inside Malaysia		Outside Malaysia
1	☐ highly prominent	1	☐ highly prominent
2	☐ moderately prominent	2	☐ moderately prominent
3	☐ not very prominent	3	☐ not very prominent

Interview No:
Date Completed:

R-17 Which do you think is more important, getting recognition for research from:

☐ Inside Malaysia

OR

☐ Outside Malaysia among the world scientific community

R-18 The following items are considered important for carrying out research. Please indicate which of these items are important for your research and whether it is available or not to you.

ITEMS	ITS IMPORTANCE		IS IT AVAILABLE TO YOU	
	IMP	NOT IMP	YES	NO
1. Libraries, Malaysian books and journals	☐ ☐	☐ ☐	☐ ☐	☐ ☐
2. Foreign books and journals	☐	☐	☐	☐
3. Laboratory facilities, equipments, specimens, and materials	☐	☐	☐	☐
4. Technical supporting staff	☐	☐	☐	☐
5. Office space	☐	☐	☐	☐
6. Time off from other duties	☐	☐	☐	☐
7. Transportation	☐	☐	☐	☐
8. Funds	☐	☐	☐	☐
9. Superior who is supportive	☐	☐	☐	☐
10. Colleagues for collaborative research	☐	☐	☐	☐
11. Accessibility to documents technical reports e.g. Govt., Statutory agencies etc.	☐	☐	☐	☐
12. Other (specify):	☐	☐	☐	☐

Interview No:
Date Completed:

R-19 What part of the following play in your research?

		Great Part	Some Part	No Part
1.	Theoratical	☐	☐	☐
2.	Methodological	☐	☐	☐
3.	Experimental	☐	☐	☐
4.	Adaptive research	☐	☐	☐
5.	Technological	☐	☐	☐
6.	Clinical	☐	☐	☐
7.	Policy-oriented	☐	☐	☐
8.	Applied	☐	☐	☐
9.	Descriptive (taxonomic)	☐	☐	☐
10.	Training of advanced students in research	☐	☐	☐

R-20 Which of the above terms best describes your work? ....
Number e.g. 1, 2 etc.

SECTION C: CONSULTING AND ADVISORY

C-1 Have you ever been a consultant and/or advisor?

1. Yes ☐ 2. No ☐

IF NO SKIP TO QUESTION N-1 PAGE 13

C-2 If you have been a consultant and or advisor in the past *five* years please indicate where you served as consultant and or advisor?

Institution/Organization/Club	Yes	No
1. National Government (specify Ministry, Department etc.)	☐	☐
2. State Government (specify Department etc.)	☐	☐
3 Local or Municipal Government (specify Department etc.)	☐	☐
4. Malaysian firms or business industry (specify)	☐	☐

Interview No:
Date Completed:

5. Foreign firms or business industry (specify)

   .... ☐ ☐

6. Southeast Asian Regional Group e.g. ASEAN, SEAMAC, etc. (specify):

   .... ☐ ☐

7. Foreign country's organization e.g. Ford Foundation, Asia Foundation etc. (specify):

   .... ☐ ☐

8. International organization e.g. UNESCO, WORLD BANK, ASIAN DEVELOPMENT BANK, WHO etc. (specify):

   .... ☐ ☐

9. Professional organization e.g. Malaysian Medical Association, Malaysian Institute of Engineers etc. (specify):

   .... ☐ ☐

10. Community organization e.g. Malaysian Youth Club, Rotary Club, Red Cross etc. (specify):

    .... ☐ ☐

11. Educational institution (specify):

    .... ☐ ☐

12. Religious organization (specify):

    .... ☐ ☐

13. Ethnic related organisation (specify):

    .... ☐ ☐

14. Other e.g. Political parties, political elites etc. (specify):

    .... ☐ ☐

TAKE *ONE* CASE OR PROJECT IN WHICH YOU FEEL THAT YOU HAVE BEEN MODERATELY SUCCESSFUL AS A CONSULTANT OR ADVISOR AND ANSWER THE FOLLOWING QUESTIONS:

C-3 What is the specific case or project in which you were a consultant or advisor?

....

Interview No:
Date Completed:

C-4 **How did you become a consultant or advisor?**

1. ☐ I tock the initiative
2. ☐ I was approached by my client
3. ☐ I was sponsored by someone
4. ☐ Other (specify). ....

C-5 **If you were sponsored by someone please indicate:**

1. Who that person was? ....
2. What is his position or rank? ....

C-6 **What is the nature of the relationship of that person to you?**

1. ☐ former classmate
2. ☐ departmental colleague
3. ☐ relative who is influential
4. ☐ best friend
5. ☐ university administrator
6. ☐ other (specify): ....

C-7 **In what capacity were you participating in this case or project?**

1. ☐ as an individual and not as a representative of any group
2. ☐ as a representative of my institution
3. ☐ as a representative of my professional field
4. ☐ other (specify): ....

C-8 **In connection with this case or project (e.g. government organization, club, etc.) please indicate what were your most important activities? Check *THREE* items which you think are most important to your role:**

1. ☐ to provide technical advice, new ideas and information on a project or program
2. ☐ to provide leadership on the project or program
3. ☐ to evaluate the project or program and to make recommendations
4. ☐ to serve as confidential consultant or advisor to my client
5. ☐ to evaluate a project or program being proposed by foreigners in terms of its suitability to Malaysian conditions
6. ☐ to interpret some aspects of the national policy to a sector or group
7. ☐ to become advisor to top senior administrators with respect to their own project or program and/or provide credibility to the project or program
8. ☐ to provide lectures to technical and administrative staff about recent knowledge and developments in my field under its in service training program

Interview No:
Date Completed:

9. ☐ to help develop a program or scheme
10. ☐ to help develop and establish research and development undertakings in an organization
11. ☐ other (specify) ....

C-9 **If the case is related to private industry or business firms (local or foreign) please indicate what you did?** IF NOT SKIP TO C-10

1. ☐ to initiate test on particular product and to use its findings to advertise the company's brand of product
2. ☐ to provide leadership and help plan a new program or project for the industry or firm
3. ☐ to provide advice, technical knowledge and information on marketing of products
4. ☐ to provide lectures to technical and administrative staff of industry or firms about recent knowledge and developments in my field under its in service training program
5. ☐ to become advisor to top executive of the industry, or firms with respect to its own project or program and/or provide credibility to the project or program
6. ☐ other (specify) ....

C-10 In connection with this case or project specify what you have done? **Check whichever apply**

1. ☐ to attend meetings within the organization and to offer suggestions
2. ☐ to prepare position papers and technical reports
3. ☐ to undertake special studies and suggest further solutions to problems
4. ☐ to offer help and advice to senior authority figure
5. ☐ other (specify) ....

C-11 **In connection with this case or project was it central to your field of specialization or to your research?**

1. Yes ☐ 2. No ☐

C-12 **Was your involvement as a consultant or advisor in this case or in the organization did give you new ideas for further research in your field?**

1. Yes ☐ 2. No ☐

UP UNTIL NOW YOU HAVE BEEN LOOKING AT A SPECIFIC CASE OF YOUR CONSULTING AND ADVISORY ROLE: TURNING TO MORE GENERAL QUESTIONS ABOUT CONSULTING AND ADVISORY ACTIVITIES PLEASE ANSWER THE FOLLOWING QUESTIONS:

Interview No:
Date Completed:

C-13 What aspects of your background do you think were considered especially important by the person, organization or group to whom you serve as consultant or advisor. Check the following categories which most apply to you:

1. ☐ Having a degree from a foreign institution
2. ☐ Having an influential sponsor
3. ☐ Having an expert knowledge in the field of specialization
4. ☐ Having the ability to speak fluent English
5. ☐ Having the ability to speak other languages e.g. Bahasa Malaysia, Chinese, French, Japanese etc. (specify): ....
6. ☐ Having the ability to interact easily with people in position of authority
7. ☐ Belonging to a particular ethnic group
8. ☐ To come from an influential family with many connections
9. ☐ Belonging to the "right" political factions
10. ☐ Having an outstanding reputation and a highly respected educator or professional person in the country
11. ☐ Coming from a particular region in the country
12. ☐ Other (specify): ....

HAVING DONE THIS PLEASE *CIRCLE* THE THREE MOST IMPORTANT CATEGORIES THAT YOU HAVE CHECKED

C-14 There are a number of rewards or advantages to be a consultant or advisor. The following are some of the rewards or advantages. Check those rewards or advantages you have obtained as consultant or advisor.

Being a consultant or advisor:

1. ☐ adds to my reputation as a scientist
2. ☐ gives me the opportunity to learn about the real problems and conditions in some sectors or organizations
3. ☐ enables me to contribute my knowledge and ideas to policymakers or administrators and others who can make use of that knowledge
4. ☐ provides me with the support to carry out research
5. ☐ gives me prestige, honor and respect
6. ☐ helps me to gain promotion in my rank or position
7. ☐ gives me opportunity to meet influential people e.g. policymakers business executives, Ministers etc. and thereby enhances my own position and status
8. ☐ brings me additional income and material benefits
9. ☐ popularizes my field of specialization and thereby creates new opportunities for our students
10. ☐ gives prestige to my university
11. ☐ helps give my professional field status and thereby opens up possibilities for future research support
12. ☐ other (specify) ....

HAVING DONE THIS PLEASE *CIRCLE* THE THREE MOST IMPORTANT CATEGORIES THAT YOU HAVE CHECKED

Interview No:
Date Completed:

C-15 Have you ever planned or initiated research based on the ideas that you learned from your experiences as consultant or advisor?

1. Yes ☐ 2. No ☐

C-16 If No, to C-15, have you ever assigned your students to do research on problems that you learned from your experiences as consultant or advisor?

1. Yes ☐ 2. No ☐

C-17 Is there some group, organization etc., to whom you would like to be consultant or advisor?

1. Yes ☐ 2. No ☐

3. If Yes, specify what group or organization:

....

4. Why this particular group or organization? specify your reasons:

....

....

....

5. What would you like to contribute? specify:

....

....

....

SECTION D: THE NETWORKS AND LINKAGES OF SCIENTISTS WITHIN THE INSTITUTION AND WITHIN THE COUNTRY

N-1 How many persons beside yourself are there in your professional field in your institution?

....

N-2 Within your institution with whom do you *SERIOUSLY* discuss, talk and exchange views about your research work and professional interests?

1. ☐ No one IF NO ONE SKIP TO N-4

2. ☐ Someone IF SOMEONE PLEASE INDICATE:

	Name (exclude foreigners)	Department	Status/Rank (e.g. advanced students, dept. colleagues, colleagues from other department)
a.	....	....	....
b.	....	....	....
c.	....	....	....
d.	....	....	....
e.	....	....	....

Interview No:
Date Completed:

N-3 Take *ONE* person indicated in N-2, with whom you have had the most meaningful discussions, talks and exchange of views about your research work and professional interests and answer the following questions:

1. How do you get to know this person?

   ....

2. How do you get together with this person? e.g. work together regularly, informal visits, family knows each other etc.

   ....

3. How often do you meet, talk, discuss and exchange views about your research work and professional interests? e.g. twice a week, three times a week etc.

   ....

N-4 If presently, there are foreign scholars in your department please specify their:

IF THERE ARE NO FOREIGN SCHOLARS IN YOUR DEPARTMENT SKIP TO N-7

Country of Origin	Is Individual		Status of Appointment			
	In Teaching	In Research	Regular	Visit	Short Contrt	Other
1.	☐	☐	☐	☐	☐	....
2.	☐	☐	☐	☐	☐	....
3.	☐	☐	☐	☐	☐	....
4.	☐	☐	☐	☐	☐	....
5.	☐	☐	☐	☐	☐	....
6.	☐	☐	☐	☐	☐	....
7.	☐	☐	☐	☐	☐	....
8.	☐	☐	☐	☐	☐	....
9.	☐	☐	☐	☐	☐	....

N-5 Among these foreign scholars with whom do you *SERIOUSLY* discuss, talks and exchange views about your research work and professional interests?

1. ☐ No one — IF NO ONE SKIP TO N-7
2. ☐ Someone — IF SOMEONE PLEASE INDICATE:

Name	Field of Specialization	Country of origin
1.	....	....
2.	....	....
3.	....	....
4.	....	....
5.	....	....

Interview No:
Date Completed:

N-6 Take ONE person in N-5, with whom you have had meaningful discussions, talks and exchange of views about your research work and professional interests answer the following questions:

1. How did you get to know this person?

....

2. How did you get together with this person? e.g. work together regularly, informal visits, family knows each other etc

....

3. How often do you meet, talk, discuss and exchange views about your research work and professional interests? e.g. twice a week, three times a week etc.

....

N-7 About how many persons are there in your professional field outside your institution in Malaysia?

....

N-8 Outside your institution in Malaysia with whom do you SERIOUSLY discuss, talk and exchange views about your research work and professional interests?

1. ☐ No one — IF NO ONE SKIP TO N 10
2. ☐ Someone — IF SOMEONE PLEASE INDICATE

Name	Institution	Position/Rank
1.	....	....
2.	....	....
3.	....	....
4.	....	....
5.	....	....

IF ANY OF THE ABOVE ARE FOREIGNERS, PLEASE CIRCLE AND INDICATE COUNTRY OF ORIGIN

N-9 Take ONE person indicated in N-8, with whom you have had meaningful discussions, talks, and exchange of views about your research work and professional interests and answer the following questions:

1. How did you get to know this person?

....

2. How did you get together with this person? e.g. work together regularly, informal visits, write letters, family knows each other etc.

....

3. How often do you meet, talk, discuss and exchange views about your research work and professional interests? e.g. once a week, once a month etc.

....

Interview No:
Date Completed:

N-10 What is your feeling toward scholars from abroad doing research in your field in Malaysia? CHECK *ONE ITEM* IN WHICH YOU AGREE

1. ☐ I welcome foreign scholars to do research in Malaysia because their research and findings contribute to the advancement of scientific knowledge
2. ☐ I welcome foreign scholars only if they do research on problems that are relevant to our country's needs and priorities
3. ☐ I welcome foreign scholars to do research only if they collaborate with local scholars
4. ☐ I welcome foreign scholars to do research only if they bring with them the newest research methods, techniques and concepts in our field which they share with us
5. ☐ If it is possible, I prefer not to have foreign scholars doing research in our country
6. ☐ other (specify): ....

N-11 How do you learn about research work that is being done in your field? CHECK *THREE* SOURCES IN WHICH YOU HAVE USED THEM

1. INSIDE MALAYSIA

1. ☐ none
2. ☐ letters
3. ☐ journals
4. ☐ books
5. ☐ seminars, workshops, conferences
6. ☐ professional scientific meetings
7. ☐ informal visits with each other
8. ☐ through mutual friends
9. ☐ articles in popular newspapers, magazines
10. ☐ scholars from abroad passing through Malaysia
11. ☐ write for reprints
12. ☐ other (specify): ....

2. OUTSIDE MALAYSIA

1. ☐ none
2. ☐ letters
3. ☐ journals
4. ☐ books
5. ☐ seminars, workshops, conferences
6. ☐ professional scientific meetings
7. ☐ former professor
8. ☐ through mutual friends
9. ☐ articles in popular newspapers, magazines
10. ☐ write for reprints
11. ☐ other (specify): ....

Interview No:
Date Completed:

N-12 How do you inform others about your research work in your field?
CHECK *THREE* SOURCES IN WHICH YOU HAVE USED THEM

1. INSIDE MALAYSIA

1. ☐ none
2. ☐ letters
3. ☐ journals
4. ☐ books
5. ☐ guest speaker at other institution
6. ☐ visit colleagues at other institution
7. ☐ through mutual friends
8. ☐ professional scientific meetings
9. ☐ scholars from abroad passing through Malaysia
10. ☐ send reprints
11. ☐ special articles in newspapers, magazines
12. ☐ other (specify): ....

2. OUTSIDE MALAYSIA

1. ☐ none
2. ☐ letters
3. ☐ journals
4. ☐ books
5. ☐ guest speaker at institution abroad
6. ☐ visit friend in a foreign country
7. ☐ professional scientific meetings
8. ☐ seminars, workshops conferences overseas
9. ☐ send reprints
10. ☐ visit from professors abroad
11. ☐ other (specify): ....

N-13 Have you ever won a prize, special award, or honor from any scientific or professional society or organization in Malaysia?

DO NOT LIST PRIZES OR AWARDS RECEIVED WHILE ENROLLED IN GRADUATE AND UNDERGRADUATE INSTITUTION

1. Yes ☐ 2. No ☐

3. If Yes, please indicate:

Name of award, prize or honor	Society/Organization awarding	Year awarded
1.	....	....
2.	....	....
3.	....	....

Interview No:
Date Completed:

SECTION E: THE NETWORKS AND LINKAGES OF SCIENTISTS ABROAD

IN-1 Who *OUTSIDE* Malaysia is working on *RESEARCH* similar to yours?

1. ☐ No one IF NO ONE SKIP TO IN-2
2. ☐ Don't know
3. ☐ Someone IF SOMEONE PLEASE INDICATE:

	Name	Institution	Country
1.	....	....	....
2.	....	....	....
3.	....	....	....
4.	....	....	....
5.	....	....	....
6.	....	....	....
7.	....	....	....
8.	....	....	....
9.	....	....	....
10.	....	....	....

IN-2 Who are the scientists in your field *OUTSIDE* Malaysia that you know *PERSONALLY* and with whom you keep in touch?

1. ☐ no one IF NO ONE SKIP TO IN-4
2. ☐ someone IF SOMEONE PLEASE INDICATE:

	Name	Institution	Country
1.	....	....	....
2.	....	....	....
3.	....	....	....
4.	....	....	....
5.	....	....	....

Interview No:
Date Completed:

IN-3 **Take** ONE person indicated in IN-2, with whom you have had the most significant and **meaningful** communication, exchange of ideas and information and answer the following questions:

1. How do you get to know that person?

....

2. How do you keep in touch with that person? e.g. correspondence, exchange of reprints, meet at international conferences, visit them in their country etc.

....

3. How often do you communicate and exchange information and ideas about your research work and professional interests? e.g. once a month, once in six months etc.

....

4. How has this person help you in your research and professional interests?

PLEASE TICK WHICHEVER APPLY

Items	This person has helped me	I have helped this person
a. collaborate in research	☐	☐
b. secure equipment needed for research and teaching	☐	☐
c. secure specimens needed for research and teaching	☐	☐
d. secure publications needed for research and teaching	☐	☐
e. secure post-doctoral appointment or placement	☐	☐
f. read and comment on manuscripts	☐	☐
g. be a host during visits	☐	☐

h. other (specify) ....

IN-4 Looking at the world as a whole where are the THREE leading centers in your field of specialization? Name the institutions and the country in which they are located

Name of Institution	Country
1.	....
2.	....
3.	....

Interview No:
Date Completed:

IN-5 How up to date are you on research in your field of specialization which are currently going on in the world?

1. ☐ well informed and up to date
2. ☐ moderately informed
3. ☐ not so well informed
4. ☐ have not been able to keep up

IN-6 In your professional field is there any Malaysian who is well known internationally?

1. Yes ☐ 2. No ☐ 3. Don't know ☐

4. If Yes, please indicate:

a. Name ....

b. Institution ....

c. What is he known for? e.g. research, administrative leadership, organizational position etc. (specify):

....

IN-7 Do you have any relationship with any external agency e.g. UNESCO, WHO, WORLD BANK, FAO, FORD FOUNDATION etc., that is found in your country?

1. Yes ☐ 2. No ☐

3. If Yes, indicate which agency:

a. ....

b. ....

c. ....

4. What is the nature of your relationship? e.g consultant, received grant for research, received support for travel etc., (specify).

....

....

....

IN-8 Individuals differ in their interests. How would you rank orders these five statements in terms of your interest order? Indicate your order of preferences in the boxes below by putting in No's: 1, 2, 3, 4 and 5.

1. Closest to my interest
2. Next closest to my interest
3. Next
4. Next
5. Furthest from my interest

☐ I want to build knowledge which will benefit a specific group (e.g. ethnic, region etc.,) specify: ....

☐ I want to build knowledge which will benefit Malaysia as a whole

☐ I want to build knowledge which will benefit Southeast Asian people

☐ I want to build knowledge which will benefit mankind as a whole

☐ I want to search for TRUTH in my field, no matter who benefited

Interview No:
Date Completed:

IN-9 Have your accomplishment in your research work gained recognition or honor for you OUTSIDE Malaysia?

1. Yes ☐ 2. No ☐ IF NO SKIP TO BD-1 SECTION F

3. If Yes, please indicate:

a. Citation of your work in published studies by other scholars from abroad

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....

b. Requests for reprints of your research article from abroad

1. ....
2. ....
3. ....
4. ....
5. ....

c. Elected to be a fellow of scientific or professional society abroad

1. ....
2. ....
3. ....
4. ....

d. Special invitation or honor e.g. to deliver lecture, presentation of paper abroad

1. ....
2. ....
3. ....

Interview No:
Date Completed:

SECTION F: BIO-DATA SHEET

BD-1 Sex: Male ☐ Female ☐

BD-2 Monthly income ....

BD-3 Place of birth: a. Village ....
b. Town ....
c. State ....

BD-4 Year of birth: ....

BD-5 Ethnic origin: a. Malay ☐
b. Chinese ☐
c. Indian ☐

BD-6 Civil status: a. married ☐
b. single ☐ IF SINGLE SKIP TO BD-8

BD-7 Total number of children: a. Sons .... b. Ages: ...., ..., ..., ..., ..., years
c. daughters .... d. Ages: ...., ..., ..., ..., years

PARENTAL BACKGROUND

BD-8 Total number of brothers and sisters: a. brothers ....
b. sisters ....
c. your birth order ....

BD-9 a. Occupation of father/or guardian when you were growing up ....
....
b. Occupation of mother when you were growing up ....
....
c. Ethnic origin of father ....
d. Ethnic origin of mother ....
e. Educational attainment of father ....
f. Educational attainment of mother ....

SPOUSE BACKGROUND

BD-10 · Place of birth of wife/husband: a. Village ....
b. Town ....
c. State ....

Interview No:
Date Completed:

BD-11 Educational attainment of wife/husband ....

BD-12 Present occupation of wife/husband ....

BD-13 Ethnic origin of wife/husband ....

BD-14 Monthly income of wife/husband ....

BD-15 Relatives in professional life:

1. Profession	Number	Studied abroad Yes	No
a. Medical doctors	....	☐	☐
b. Engineers	....	☐	☐
c. Lawyers	....	☐	☐
d. Educators-primary, secondary schools	....	☐	☐
e. Educators-college, university	....	☐	☐
f. Executive and management in government	....	☐	☐
g. Executive and management in industry or firms	....	☐	☐
h. Executive and management in University	....	☐	☐

2. Were any one of these persons influential in your aspiration and choice of career?

1. Yes ☐ 2. No ☐

3. If Yes, please indicate: ....

....

HIGHER EDUCATION

BD 16 Please indicate below the institutions you attended beginning with your *LAST* secondary school attended, including any foreign education, years attended, degree earned, if any.

Name of Institution and location	Dates attended From.....To.....	Specialization	Degree or Cert	Year
1.	....	....	....	....
2.	....	....	....	....
3.	....	....	....	....
4.	....	....	....	....

Interview No:
Date Completed:

BD-17 **CAREER HISTORY**

Beginning with the first position or job you had, fill up to the present.

(NOTE: IF APPLICABLE, BE SURE TO INCLUDE PRIVATE PRACTICE)

Position/Rank	Fulltime/ Part time	Institution/ Employer	From	To
1.	....	....	....	....
2.	....	....	....	....
3.	....	....	....	....
4.	....	....	....	....
5.	....	....	....	....

BD-18 **RESEARCH HISTORY**

Starting with the first one please indicate the research projects have you been on?

Position on Research project (Principal investigator or Co-investigator)	Year From	To	How supported	Where was research done
1.	....	....	....	....
2.	....	....	....	....
3.	....	....	....	....
4.	....	....	....	....
5.	....	....	....	....
6.	....	....	....	....
7.	....	....	....	....
8.	....	....	....	....
9.	....	....	....	....
10....................................	....	....	....	....
11....................................	....	....	....	....
12....................................	....	....	....	....
13....................................	....	....	....	....
14....................................	....	....	....	....
15....................................	....	....	....	....
16....................................	....	....	....	....
17....................................	....	....	....	....

Interview No:
Date Completed:

BD-19 BIBLIOGRAPHY

1. Please indicate scientific papers and professional writings including journals, books, monographs, technical reports to government agencies or private industry, research articles, proceedings and bulletins etc.

	Author/Coauthor	Title	Country published	Year
1.	....	....	....	....
2.	....	....	....	....
3.	....	....	....	....
4.	....	....	....	....
5.	....	....	....	....
6.	....	....	....	....
7.	....	....	....	....
8.	....	....	....	....
9.	....	....	....	....
10.	....	....	....	....

Interview No:
Date Completed:

2. Please indicate articles in popular newspapers magazines and lectures on professional related topics to any civic groups, professional society, and other similar groups etc.

	Title	Where given	Year
1.	....	....	....
2.	....	....	....
3.	....	....	....
4	....	....	....
5.	....	....	....
6.	....	....	....
7.	....	....	....
8	....	....	....
9	....	....	....
10	....	....	....

IF NOT ENOUGH SPACE PLEASE WRITE IN THE BACK OF THIS SHEET

BD 20 **CONFERENCES, SEMINARS, WORKSHOPS**

In the last *THREE* years, what conferences, seminars, and workshops have you attended in connection with your work and professional interests? Please include both national and international functions:

	Name of conferences, Seminars, workshops	Where Held	Year	Your main role e.g. observer, present paper, organizer
	INSIDE MALAYSIA			
1.	....	....	....	....
2.	....	....	....	....
3.	....	....	....	....
4.	....	....	....	....
5.	....	....	....	....
6.	....	....	....	....

	OUTSIDE MALAYSIA	Where Held	Year	Sources of Funding	Your main role e.g. observer, present paper, organizer
1.	....	....	....	....	....
2.	....	....	....	....	....
3.	....	....	....	....	....
4.	....	....	....	....	....
5.	....	....	....	....	....

Interview No:
Date Completed:

BD-21 MEMBERSHIP IN SCIENTIFIC AND PROFESSIONAL ASSOCIATION

1. Is there a scientific organization or association for your field in Malaysia?

   1. Yes ☐   2. No ☐

   3. If Yes, what is its name?

   ....

2. Are you a member of this scientific association?

   1. Yes ☐   2. No ☐

3. Does this scientific association publish its own journal newsletter, bulletin etc.?

   1. Yes ☐   2. No ☐

   3. If Yes, what is its title?

   ....

4. Please indicate membership in other scientific or professional association in Malaysia?

   a. ....

   b. ....

   c. ....

5. Please indicate membership in scientific or professional society outside Malaysia?

   a. ....

   b. ....

   c. ....

   d. ....

   e. ....

THIS IS THE END OF THE QUESTIONNAIRE. WE HOPE YOU HAVE ENJOYED TAKING PART IN THIS RESEARCH.

THANK YOU VERY MUCH.

MICHIGAN STATE UNIV. LIBRARIES
31293100382765