SCIENCE POLICY IN THE PHILIPPINES: THE EDUCATION AND TRAINING OF SCIENTISTS AND ENGINEERS

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1980

Science Policy in the Philippines: The Education and Training of Scientists and Engineers

by

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A thesis submitted to the Department of Political Studies
in conformity with the requirements for
the Degree of Doctor of Philosophy

VOLUME ONE

Queen's University
Kingston, Ontario, Canada

August 1980

Abstract

Olivia C. Caoili: Science Policy in the Philippines: The Education and Training of Scientists and Engineers, Ph.D. Thesis, Queen's University at Kingston, Ontario, Canada, August 1980.

The purpose of this thesis is to examine science policies that have been pursued in the Philippines since 1946, with particular reference to the education and training of scientists, engineers and physicians, and the movement towards integrated policy-making for higher education and for the advancement of science and technology in the context of national development plans. The study accordingly looks at the unemployment and underemployment of professionals and their emigration to other countries; policy-making for higher education; professional organizations, their role in education and policy-formulation; employment of trained manpower; governmental machinery for policy-making and implementation for science and technology; and the perceptions of science administrators, educators, scientists, engineers and physicians. To put matters in perspective, it was necessary to probe the history of institutions and policies in some depth.

The study found that there have been relatively few graduates in the sciences, engineering and medicine and these were concentrated in urban areas. Many faced unemployment and underemployment. This fact, and the dearth of facilities for graduate studies in the Philippines, have led many professionals to study abroad and later emigrate. With the expansion of governmental functions, universities and colleges, and the growth of industry, there is increasing need for these highly-qualified people.

Past policies on higher education, scientific research, and economic development were adopted without much consideration for their interrelation. This study analyzes the progress made towards a unified education and science policy and concludes with recommendations for policymakers and educators to consider.

Preface and Acknowledgements

This study is based on library research on science policy, laws, documents, annual reports, newspaper clippings, university/college catalogues and information bulletins, questionnaire surveys, and interviews with government, university and college administrators in the Philippines.

Several surveys were made. The first, based on questionnaires only, was a survey of Filipino physicians who had emigrated to the United States. The survey was conducted between April and October 1975. The second survey used personal interviews as well as questionnaires. This was a survey of participants in the Balik-Scientist Program (BSP) and was carried out between November 1976 and March 1977. There is a preliminary analysis of the BSP survey in my paper, "Reversing the Brain Drain: The 'Balik' Scientist Program in the Philippines," Occasional Paper No. 12, Manila: University of the Philippines, College of Public Administration, November 1978.

Interviews with science agency officials, science educators, officers of professional organizations and others, and surveys of educational institutions were done in the Philippines during the period May 1976 to August 1977.

The organizational structure depicted in this study has inevitably undergone some changes since August 1977. As far as possible, these changes have been footnoted. New government agencies and departments have been created and all departments are now designated ministries and are headed by ministers rather than secretaries. Hence, the Department of Education and Culture, for example, is now the Ministry of Education and Culture headed by the Minister for Education and Culture. The Chairman of the National Science Development Board has likewise been designated Minister, reflecting the Cabinet status of NSDB. To avoid unnecessary confusion of details, however, these changes in nomenclature were not made in the text. The basic authority relations among the departments and agencies covered by the study remain unaltered.

No previous attempt, to my knowledge, has been made to organize in a single work an integrated analysis of the scattered historical, legislative, organizational and empirical materials on higher education and science policy in the Philippines. I have tried to accomplish this in this study. This explains my inclusion of many details,and, hence, my rather lengthy dissertation. It is my hope that in writing this, I have contributed in generating more interest and facilitating further research in this increasingly important area of public policy.

In making this study, I received help from many people and several institutions, to whom my thanks are due.

I am deeply indebted to my thesis supervisor, Professor J.W. Grove, for providing the necessary academic stimulus that led me into this study. With his modest but challenging and inspiring ways, his broad outlook and profound insights on science policy, I found much constructive intellectual guidance in the tedious task of integrating the mass of data and weaving my ideas into a more coherent dissertation.

Professor W. P. Irvine provided generous, helpful comments on my questionnaires. Professor C.E.S. Franks gave perceptive advice on my early outline for the study and patiently read the manuscript.

To my interviewees who generously consented to answer my questions and gave leads on further data sources and to all the respondents who patiently completed my questionnaires, I am sincerely grateful.

Great thanks are due to the International Development Research Centre, Canada, for its financial support for one year of field research in the Philippines and two years of my residence at Queen's University to write up this study; to the Educational Development Projects Implementing Task Force, Philippines, for giving me six months stipend to support my writing; to the University of the Philippines at Los Baños for giving me the necessary leave to gather my data and complete my degree; and to the Department of Political Studies, Queen's University, for making possible the questionnaire survey of Filipino physicians and medical scientists who had emigrated to the United States. Special mention goes to the staff of Douglas Library of Queen's University for tracking down for me a number of materials from its shelves and through its interlibrary loan service.

I wish to thank all my colleagues and friends who provided encouragement and assistance in obtaining certain materials.

My appreciation goes to Fanny Calucag and Patti Candido for the typing of this thesis.

To my husband, I owe much help for checking details, constructive comments, but most of all, I am grateful for his steadfast personal support, without which this study may never have gone beyond conception.

Finally, I must thank Salvador Eugenio for patiently putting up with all the inconveniences of having a student mother and for providing humor to preserve my sanity.

Whatever errors and shortcomings this study may have must ultimately be mine alone.

Olivia C. Caoili
Kingston, Canada
Summer 1980

Biographical Sketch of Author

Born in Laoag, Ilocos Norte, Philippines, on 29 November 1940, OLIVIA C. CAOILI was educated in her country's public school system. Mrs. Caoili received the Bachelor of Arts, *cum laude*, from the University of the Philippines in 1961 and the Master of Arts from the University of Hawaii in 1965. She also took courses in Cornell University as part of her M.A. program. She was enrolled for the Doctor of Philosophy in Political Studies at Queen's University, Kingston, Ontario, Canada, from September 1972 to August 1980.

The author has done research and has taught at the University of the Philippines and was Assistant Professor at the University of the East, Manila, during the period 1965-1970. She is presently on leave from her position as Researcher at the Center for Policy and Development Studies, University of the Philippines at Los Baños.

Her research publications include the following:

"The Ilchman-Uphoff Model of Political Economy: An Operational Research Design on Social Status," *Philippine Journal of Public Administration*, Vol. XX, No. 2 (April 1976), pp. 180-192.

"The Critical Rationalist Alternative," *Philippine Political Science Journal*, No. 4 (December 1976), pp. 91-111.

"The Psychological Dimensions of Development: Implications for Policy," *Philippine Planning Journal*, Vol. VIII, No. 2 (April 1977), pp. 31-41.

"Reversing the Brain Drain: The 'Balik' Scientist Program in the Philippines," Occasional Paper No. 12, College of Public Administration, University of the Philippines (November 1978, 20 pp., mimeo.).

Mrs. Caoili is a member of the Philippine Political Science Association and the Canadian Political Science Association.

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Frequently Used Abbreviations

ACAP -- Association of Colleges of Agriculture in the Philippines

APMC -- Association of Philippine Medical Colleges

BNE -- Board of National Education (now NBE or National Board of Education)

BSP -- Balik-Scientist Program

ComVol -- Commission on Volcanology

COTASP -- Council of Organizations on Technological and Allied Sciences of the Philippines

CSTO -- Center for Scientific and Technological Organizations

DA -- Department of Agriculture

DEC -- Department of Education and Culture

DNR -- Department of Natural Resources

DOT -- Department of Tourism

EDB -- Energy Development Board

EDPITAF -- Educational Development Projects Implementing Task Force, Department of Education and Culture

FNRI -- Food and Nutrition Research Institute

FORPRIDECOM -- Forest Products Research and Industries Development Commission

IRRI -- International Rice Research Institute

MIRDC -- Metals Industry Research and Development Center

MMA -- Metropolitan Manila Area

NEDA -- National Economic and Development Authority

NIST -- National Institute of Science and Technology

NMYC -- National Manpower and Youth Council

NPCC -- National Pollution Control Commission

NRCP -- National Research Council of the Philippines

NSDB -- National Science Development Board

OCPC -- Office of Compensation and Position Classification (formerly WAPCO or Wage and Position Classification Office)

OECD -- Organization for Economic Co-operation and Development

PAEC -- Philippine Atomic Energy Commission

PCARR -- Philippine Council for Agriculture and Resources Research

PCSPE -- Presidential Commission to Survey Philippine Education

PhilAAS -- Philippine Association for the Advancement of Science

PIC -- Philippine Inventors Commission

PICE -- Philippine Institute of Civil Engineers

PICHE -- Philippine Institute of Chemical Engineers

PMA -- Philippine Medical Association

PNOC -- Philippine National Oil Commission

PRC -- Professional Regulation Commission

PSHS -- Philippine Science High School

PTRI -- Philippine Textile Research Institute

SEARCA -- Southeast Asian Regional Center for Graduate Study in Agriculture

SFP -- Science Foundation of the Philippines

TRC -- Technology Resource Center

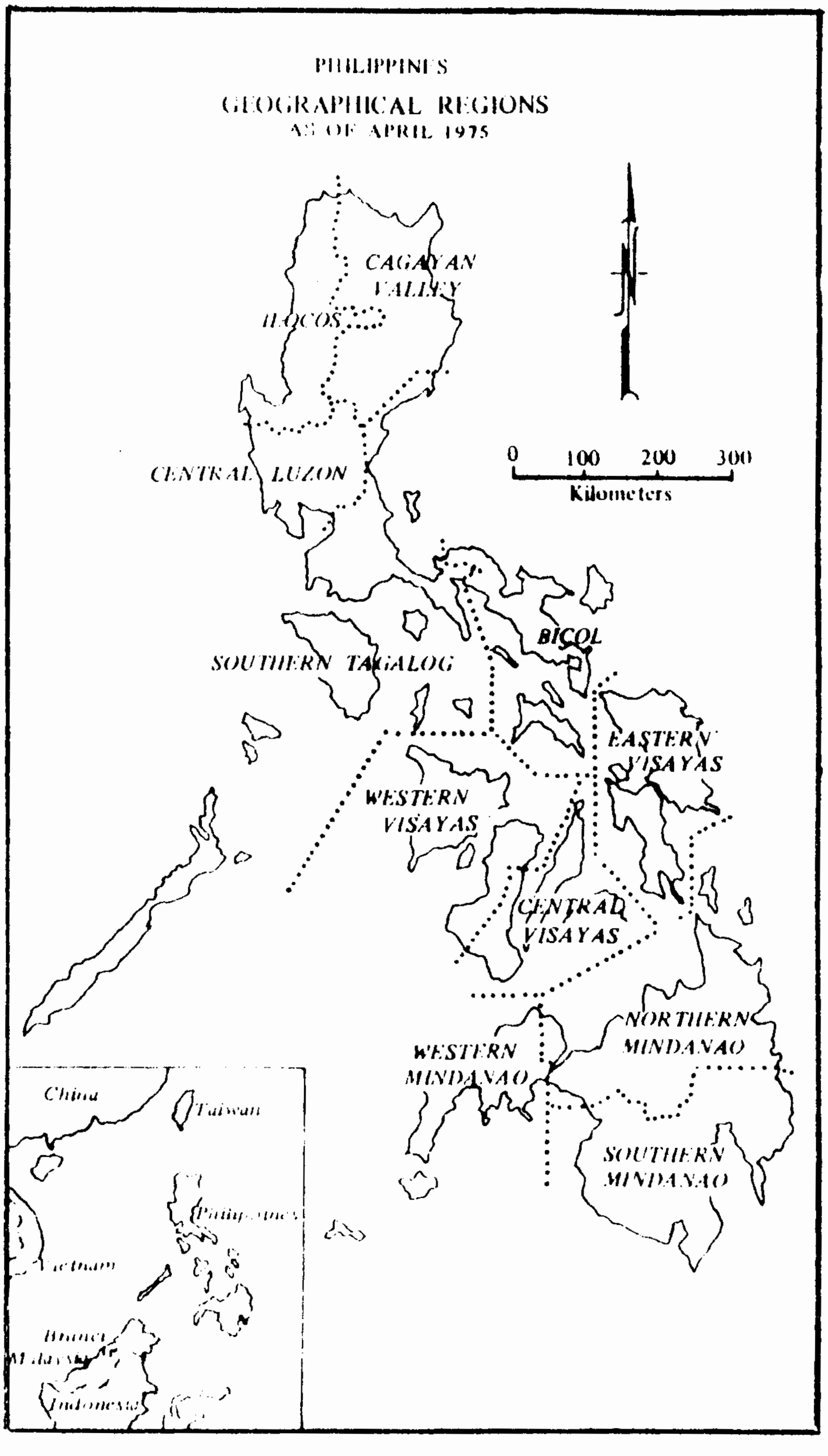
UNCTAD -- United Nations Commission for Trade and Development

UNESCO -- United Nations Educational, Scientific and Cultural Organization

UNITAR -- United Nations Institute for Training and Research

UP -- University of the Philippines

UPLB -- University of the Philippines at Los Baños


PHILIPPINES
GEOGRAPHICAL REGIONS
AS OF APRIL 1975
CAGAYAN VALLEY
ILOCOS
CENTRAL LUZON
0 100 200 300
Kilometers
BICOL
SOUTHERN TAGALOG
EASTERN VISAYAS
WESTERN VISAYAS
CENTRAL VISAYAS
NORTHERN MINDANAO
WESTERN MINDANAO
SOUTHERN MINDANAO
China
Taiwan

Chapter I

Introduction

Rapid economic development and the improvement of the quality of life and of society are goals which developing states have been striving for since the attainment of their political independence. To achieve these goals, they must choose programs and strategies which are deemed appropriate to their available resources and existing level of development. There has been a tendency for these countries to look at the experience of the industrialized states for possible guides in the formulation of their national development plans. It is widely recognized that socioeconomic progress among the industrialized states has been propelled by the advance of science and technology. In recent years, however, it has become more apparent that the widespread application of advances in science and technology in these industrialized countries can have harmful unforeseen consequences such as, for example, environmental pollution, problems of urbanization, industrial health hazards, and others,which threaten to negate the very achievements of these societies. In the field of technical cooperation between developed and developing states, it has also been observed that the uncritical adoption and diffusion of science and technology from the industrialized states can lead to a waste of valuable resources in the developing states and may even seriously disrupt their existing social systems, thus creating more problems. This shows that

> Transferring technologies is not as simple as transferring funds. Innovation requires change but not disruption; the new systems must be congruent with the basic dimensions of the old. The search for congruence between technological

and social systems begin with efforts to predict the consequences of innovation.[1]

All states, both developed and developing, thus face the dilemma of how to make optimum use of science and technology while at the same time preventing and controlling their deleterious effects. It is this dilemma which has elevated the formulation of science policy to the forefront of serious deliberation by governments as a vital part of their national plans and policies.

The Concept of Science Policy

Science policy is generally used to refer to "the collective measures taken by a government in order, on the one hand, to encourage the development of scientific and technical research, and on the other, to exploit the results of this research for general political objectives."[2] Science policy in this context can be analytically divided into two parts: "policy for (or in) science" designed to foster research and the growth of knowledge, and "policy through science" or "science for (or in) policy" which involves the exploitation or application of the fruits of science and technology in various areas of public concern such as, for example, public health, pollution,

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[1] John D. Montgomery, Technology and Civic Life: Making and Implementing Development Decisions (Cambridge, Mass.: The M.I.T. Press, 1974), p. 147.

[2] Jean-Jacques Salomon, "Science Policy Studies and the Development of Science Policy," in Ina Spiegel-Rosing and Derek de Solla Price, eds., Science, Technology and Society: A Cross-Disciplinary Perspective (London and Beverly Hills: Sage Publications, 1977), pp. 45-46. Underscoring by Salomon.

urban problems, and the like.[3] In practice, however, these two aspects of science policy are closely interrelated and can hardly be separated.

The formulation of science policy means asking such questions as:

> What percentage of total national resources should science and technology get, in the light of alternative claims on these resources? Within science and technology, how should funds and technical manpower be divided among basic research, applied research and development? And how within science, between physics and oceanography? How many scientists and engineers should the country train? What kinds of research institutions and facilities should it provide them with? What government machinery is required to answer such questions about science and what technical sophistication is needed by the public servants who have to answer them?[4]

It is useful, in this connection, to distinguish between science and technology. Although there are many different ways of defining science, it is commonly regarded as being concerned with the systematic understanding and explanation of the laws of nature.[5] Scientific activity centers on research, the end result of which is the discovery or production of new knowledge. Scientific research is usually categorized as basic (fundamental) or applied in nature depending on whether its results are expected to have long-run or immediate utility. Such

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[3] OECD, Science, Growth and Society; A New Perspective (Paris: OECD, 1971), p. 37; Jacques Spaey et al, Science for Development, An Essay on the Origin and Organization of Science Policies (Paris: UNESCO, 1971), p. 35; G. Bruce Doern, Science and Politics in Canada (Montreal: McGill-Queen's University Press, 1972), pp. 167-168.

[4] Emmanuel Mesthene, "The Impact of Science on Public Policy," Public Administration Review, Vol. XXVII, No. 2 (June 1967), p. 103.

[5] Jerome R. Ravetz, Scientific Knowledge and Its Social Problems (Oxford:Clarendon Press, 1971), Ch. 1; James B. Conant, Science and Common Sense (New Haven and London: Yale University Press, 1974), Ch. 2; Bernard Dixon, What is Science For (New York: Harper and Row, 1973), Ch. 2; David Knight, The Nature of Science; The History of Science in Western Culture Since 1600 (London: Andre Deutsch, 1976), Chs. 1-2.

a distinction, according to Brooks, is also based on the factors influencing a researcher's choice between alternative courses of action. Thus,

> If each choice is influenced almost entirely by the conceptual structure of the subject rather than by the ultimate utility of the results, then research is generally said to be basic or fundamental, even though the general subject may relate to possible applications.... The fact that research is basic does not mean that results lack utility, but only that utility is not the primary factor in the choice of direction for each successive step.[6]

Research that is aimed towards immediate use or application is called applied or targeted research.[7] However, applied or targeted research can also be "highly fundamental in character in that it has an important impact on the conceptual structure or outlook of a field."[8]

Technology originally meant "systematic knowledge of the industrial arts."[9] As this knowledge was implemented by means of techniques, technology has become commonly taken to mean both the knowledge and the means of its utilization, that is,"a body of knowledge about techniques."[10]

In the past, the practice of science and technology tended to be

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[6]Harvey Brooks, The Government of Science (Cambridge, Mass.: The M.I.T. Press, 1968), pp. 283-286.

[7]Targeted research is "the application of existing knowledge to a specific target," See Salvador E. Luria, "Goals of Science," Bulletin of the Atomic Scientists, Vol. 33, No. 5 (May 1977), pp. 29-30.

[8]Brooks, op. cit., pp. 285-286.

[9]E. Layton, "Conditions of Technological Development," in Rosing and Price, op. cit., p. 199.

[10]C. Freeman, "Economics of Research and Development," in Rosing and Price, ibid., p. 235.

unconnected. Scientific knowledge grew mainly as the product of intellectual curiosity about the nature of the world. Technology was developed by craftsmen whose inventions were often the results of intuition, trial and error,in response to human needs. For a long time, science and technology, knowledge and action, were thus pursued separately. By the nineteenth century, however, science and technology had become more closely interrelated.[11] Scientific discoveries stimulated many inventions which led to the development of science-based industries. At the same time, technological progress such as, for example, the improvements in the manufacture of optics and other scientific instruments, facilitated further testing and discovery of new scientific theories.[12]

This productive wedding between science and technology has given rise to the idea that technology is applied science. Consequently, there is often considerable ambiguity in the use of the concepts of science and technology, especially because in the contemporary world systematic research has become an important activity in both fields. However, Price makes a practical distinction between science and technology, thus:

> If, when a man labors, the main outcome of his research is knowledge, something that has to be published openly for a claim to be made, then he has done science. If, on the other hand, the product of his labor is primarily a thing, a chemical, a process, something to be

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[11] Peter Mathias, "Who Unbound Prometheus? Science and Technical Change, 1600-1800," in Science and Society 1600-1900, ed. by Peter Mathias (Cambridge: Cambridge University Press, 1972), pp. 54-80.

[12] Brooks, op. cit., pp. 293-296, 303-307.

bought and sold, then he has done technology.[13]

The close interaction between science and technology accelerated the process of industrialization and economic development among Western states. This has led to the widespread acceptance of the necessity for governments to adopt measures for the advancement of science and technology as means to the achievement of national ends and purposes. These include the creation and support of universities and other training institutes, curiosity-oriented and mission-oriented research establishments, and policies to encourage industrial research and development in the private sector. These have become part of a nation's science policy.

Evolution of Science Policy in the Industrialized Countries

The widespread concern with national science policy is of recent origin. It is in fact a post-World War II phenomenon. The idea that the state should support and promote science and technology for the benefit of society, however, had been advocated since the seventeenth century by philosophers such as, for example, Descartes, Bacon, Maupertuis and Condorcet.[14] Nevertheless, the advancement of science and technology generally proceeded, until the latter part of the nine-

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[13] Derek de Solla Price, Science Since Babylon, Enlarged edition (New Haven: Yale University Press, 1975), p. 125. Maurice Korach argues that the term "science of industry" is more appropriate to use for applied science or technology. See Korach's "The Science of Industry," in Maurice Goldsmith and Alan Mackay, eds., Society and Science (New York: Simon and Schuster, 1964), pp. 179-194.

[14] Jean-Jacques Salomon, Science and Politics; translated by Noel Lindsay (London and Basingstoke: MacMillan, 1973), pp. 6-20; J.R. Ravetz, "... et augebitur scientia," in Rom Harré, ed., Problems of Scientific Revolution; Progress and Obstacles to Progress in the Sciences; The Herbert Spencer Lectures, 1973 (Oxford: Clarendon Press, 1975), pp. 42, 48-51.

teenth century, with little if any organized government support or intervention. The progress of modern science was, for the most part, due to the work of individuals -- amateur scientists working in Europe, particularly in England, France, the Netherlands, Germany, Austria and the Scandinavian countries, during the seventeenth and eighteenth centuries.[15] They were by no means dilettantes. They were amateurs only in the sense that their gainful employment or main occupation were often unconnected with their science.[16]

Communication among these early scientists was initially by social networks and private correspondence. Later, however, they held informal gatherings to exchange scientific information. Such gatherings eventually gave rise to the organization of scientific societies such as, for example, the Accademia dei Lincei in Rome (1600-1630), the Accademia del Cimento in Florence (1657-1667), the Royal Society of London (which was given its royal charter in 1662), the Academie des Sciences in Paris (which became a royal institution in 1666), the Societas Ereunetica (1622) and Collegium Naturae Curiosorum (1651) in Germany.[17] Of these, the Royal Society and the (French) Academie des Sciences served as models for the subsequent creation of national scientific societies such as the Berlin Academy in 1700 and the National Academy

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[15] Martha Ornstein, The Role of Scientific Societies in the Seventeenth Century (published by the University of Chicago, 1928, reprinted in London: Archon Books, 1963), ch. 2.

[16] D.S.L. Cardwell, The Organization of Science in England; a Retrospect (Melbourne: Heinemann, 1957), pp. 12-14.

[17] Ornstein, op. cit., chs. 3-6.

of Sciences in the United States in 1863.[18] These societies functioned initially with little financial support from the government. They aided early scientific experiments and research by their members and also facilitated the dissemination of scientific knowledge through the publication of their transactions and scientific journals.[19]

The advances in science and technology in the eighteenth century provided impetus to the Industrial Revolution. Owing partly to the close social interaction of its amateur scientists and entrepreneurs, Britain led Europe in industrial and economic progress.[20] It was in France, and later Germany, however, where the development of science, primarily in the field of scientific and technical education, found increasing government support. The Ecole Polytechnique, the first college of applied science in the world, and other technical schools were set up in France during the last decade of the eighteenth century.[21] In Germany, state-supported universities providing training in scientific research and technical schools had become well established by the first quarter of the nineteenth century.[22] It was this development

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[18] Ibid., pp. 177-197; A. Hunter Dupree, Science in the Federal Government; A History of Policies and Activities to 1940 (Cambridge, Mass.: Harvard University Press, 1957), p. 138.

[19] Ornstein, op. cit., ch. 7.

[20] For examples of these fruitful interaction, see Sir Solly Zuckerman, Beyond the Ivory Tower; the Frontiers of Public and Private Science (London: Weidenfeld and Nicolson, 1970), ch. 13; Desmond King-Hele, Doctor of Revolution; the Life and Genius of Erasmus Darwin (London: Faber and Faber, 1977), chs. 4-5.

[21] Robert G. Gilpin, Jr., France in the Age of the Scientific State (Princeton, N.J.: Princeton University Press, 1968), ch. 4; Joseph Ben-David, The Scientist's Role in Society; A Comparative Study (Englewood Cliffs, N.J.: Prentice-Hall, 1971), pp. 94-104.

[22] Cardwell, op. cit., pp. 19-25; Ben-David, op. cit., pp. 108-127.

of professional scientific and technical manpower which enabled Germany to build its science-based industries and catch up with England as the leading industrial state in Europe by the end of the nineteenth century.[23]

While these changes in Germany were in progress, there arose a widespread feeling among Englishmen that science was in decline in their country. Charles Babbage, a leading mathematician and inventor writing in 1830, attributed this decline to the lack of recognition of science and scientists in Britain compared to France and Germany (Prussia), the "corrupt" state of the Royal Society, and the failure to teach science properly in the universities and schools of Britain.[24] The formation of the British Association for the Advancement of Science in 1831 was a direct consequence of these criticisms on the state of science in England. From 1840 to 1890, there was growing clamor for reforms in science and education. These reform movements led to state support for science education through the creation of new colleges and schools, the creation of a Science and Art Department, a system of examinations and changes in the curricula of the older universities.[25] A movement for the "Endowment of Research", which gathered in strength from 1860 to 1875, argued that pure research was basic to the nation's material prosperity and should thus be given more financial support by the state. The goal of this reform subsequently developed into the "Endowment of

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[23] Hilary Rose and Steven Rose, Science and Society (London: The Penguin Press, 1969),pp. 28-36.

[24] Charles Babbage, Reflections on the Decline of Science in England and Some of Its Causes (London, 1830, reissued in Shannon, Ireland; Irish University Press, 1971).

[25] Cardwell, op. cit., chs. 3-5; Robert H. Kargon, Science in Victorian Manchester; Enterprise and Expertise (Baltimore and London: The Johns Hopkins Press, 1977).

Science" in 1876-1880.[26]

The growing demands for reforms in science and education in Britain reflected the changing character of the scientific enterprise during the nineteenth century. Scientific research was no longer the preserve of the gentleman amateur with wealthy patrons. It had become a specialized and full-time activity. It had also become more expensive and beyond the means of most individuals. Moreover, the prosperity brought about by the science-based industries in Germany had demonstrated the long-term utilitarian value of scientific research. The net result of these reform movements were the growth of university, government and private research establishments and fellowship schemes towards the end of the nineteenth century. In 1900, the National Physical Laboratory was set up.[27] From 1900-1915, state fellowships for research were created.

The turn of the century thus saw increasing relations between government and science. Science had already been introduced in the British civil service. Government agencies using science had grown in number not only in Britain but also in the United States and Canada.[28] However, there was still no science policy in the sense that present governments are concerned with, i.e. overall planning, support and

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[26] Roy M. MacLeod, "Resources of Science in Victorian England; The Endowment of Science Movement, 1868-1900," in Mathias, ed., Science and Society 1600-1900, op. cit., pp. 111-166.

[27] Russell Moseley, "Origins and Early Years of the National Physical Laboratory: A Chapter in the Pre-history of British Science Policy," Minerva, Vol. XVI, No. 2 (Summer 1978), pp. 222-250.

[28] These were in the areas of geological surveys and exploration, agriculture, medicine and public health. Dupree, op. cit., chs. 5, 8, 10, 13-14; Doern, op. cit., pp. 2-3, 17.

coordination of scientific and technological activities.

World War I marked the beginning of the extensive entanglement of scientists with government. It was the first time in which scientists on both sides, i.e. England, France and Germany, were mobilized to devote their science to the war effort. The War subsequently gave rise in England to the creation of the Department of Scientific and Industrial Research (DSIR) in 1916. The DSIR represented the first government attempt to organize and coordinate scientific research on a large scale.[29] National Research Councils were similarly established in the United States and in Canada in 1917, in response to the wartime need to rationalize scientific research.[30]

In the period following World War I, closer relations between science and government developed further. As a consequence of the Russian Revolution and the establishment of the Soviet state, science was mobilized to serve communist ideology and the state. In the the Soviet Union, science was not only "recognized as a national capital asset, but it was also proclaimed a public service and integrated in the forces of production."[31] Central government planning and coordination of scientific research for purposes of economic development thus became institutionalized in the Soviet Union.[32] The phenomenal achievement

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[29] Rose and Rose, op. cit., ch. 3; Ian Varcoe, Organizing for Science in Britain; A Case Study (London: Oxford University Press, 1974).

[30] Dupree, op. cit., ch. 16; Doern, op. cit., pp. 3-5; 22-37.

[31] Salomon, Science and Politics, op. cit., pp. 30-42; the quotation is from pp. 33-34.

[32] Loren R. Graham, "The Development of Science Policy in the Soviet Union," in T. Dixon Long and Christopher Wright, eds., Science Policies of Industrial Nations (New York: Praeger, 1975), pp. 19-31; Robert A. Lewis, "Government and the Technological Sciences in the Soviet Union: The Rise of the Academy of Sciences," Minerva, Vol. XV, No. 2 (Summer 1977), pp. 174-199.

of Russian industrialization within a short period after the Revolution was largely attributed to the policies that the Soviet government had adopted for science. This gave rise to the belief that science could and should be planned for the benefit of society.

In England, this belief inspired the "Social Relations of Science" Movement which flourished in the 1930s to the mid-1940s. The SRS movement was spearheaded by influential scientists such as, for example, J.B.S. Haldane, Hyman Levy, Julian Huxley, Lancelot Hogben, P.M.S. Blackett, J.G. Crowther and J.D. Bernal.[33] The economic depression of the 1930s strengthened the belief of these scientists on the relations of science and society. Science if planned could improve immeasurably the human condition. Bernal eloquently expounded this idea in his book, The Social Function of Science, published in 1939. As he put it:

> Science has ceased to be the occupation of curious gentlemen or of ingenious minds supported by wealthy patrons, and has become an industry supported by large industrial monopolies and by the State. Imperceptibly this has altered the character of science from an individual to a collective basis, and has enhanced the importance of apparatus and administration. But as these developments have proceeded in an uncoordinated and haphazard manner, the result at the present day is a structure of appalling inefficiency both as to its internal organization and as to the means of application to problems of production or of welfare. If science is to be of full use to society, it must first put its own house in order. This is a task of extraordinary difficulty, because of the danger of any organization of science destroying that originality and spontaneity which are essential to its progress. Science can never be administered as part of a civil service, but recent developments here and abroad, particularly in the U.S.S.R., point to the

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[33] Robert E. Filner, "The Roots of Political Activism in British Science," Bulletin of the Atomic Scientists, Vol. 32, No. 1 (January 1976), pp. 25-29; and his "Science and Politics in England, 1930-1945: The Social Relations of Science Movement" (Ph.D. dissertation submitted to Cornell University, Ithaca, New York, May 1973), chs. 1-4; Gary Werskey, The Visible College (London: Allen Lane, 1978).

> possibility of combining freedom and efficiency in scientific organization.[34]

Bernal examined the existing organization of scientific research in Britain, science in education and the application of science and suggested remedies. His recommendations touched on the training of the scientist, the reorganization of research, scientific communication and the financing of science. The reorganization of science, in Bernal's view, must be a comprehensive task and "cannot be undertaken alone either by scientific workers themselves or by the State or economic organizations outside science, but only by all working together in an agreed direction." The question of "whether science can be reorganized at all is not simply or even principally one for scientists" but is a "social and political question. Every aspect of any reorganization of science concerns the economic and political structure of society."[35]

The idea of planning science was roundly criticized by many scientists and the anti-planning movement was led by J.R. Baker and Michael Polanyi who saw planning as inimical to the nature of the scientific enterprise. They formed the Society for Freedom in Science in 1941 to counteract the views and activities of Bernal's group and to safeguard the traditional independence of scientific inquiry.[36] The debate over planning versus freedom in science continued until the end

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[34] J.D. Bernal, The Social Function of Science (London: Routledge and Kegan Paul, 1939, reissued in Cambridge, Mass.: The M.I.T. Press, 1967), p. xiii.

[35] Ibid., p. 241.

[36] Filner,"Science and Politics in England,"op. cit., chs. 5-6; William McGucken, "On Freedom and Planning in Science: The Society for Freedom in Science, 1940-46," Minerva, Vol. XVI, No. 1 (Spring 1978), pp. 42-72.

of the second world war, although by that time the differences between the two views had narrowed considerably.

The outbreak of World War II saw the mobilization of scientists and engineers by governments in an unprecedented scale. They were engaged in weapons research and development as well as research to produce synthetic substitutes for many raw materials that had been made scarce by the war. This wartime experience demonstrated that scientific and technological progress can be greatly accelerated by organized government support and coordination of research.[37] The fruits of such scientific and technological enterprise can, moreover, be geared towards priorities of national policy. Thus after the War, the formulation of a national science policy became an important objective of policy-making among the industrialized states. This can be seen, for example, in the formation in Britain of the Advisory Council on Scientific Policy in 1947, the subsequent science policy debates and the reorganization of the scientific establishment;[38] the revitalization of the National Center for Scientific Research (CNRS) and establishment of the Atomic

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[37] Rose and Rose, op. cit., ch. 4; Dupree, op. cit., pp. 369-375; J. Stephan Dupre and Sanford A. Lakoff, Science and the Nation; Policy and Politics (Englewood Cliffs, N.J.: Prentice-Hall, 1962), pp. 9-11, 91-103; Robert Gilpin, "Introduction: Natural Scientists in Policy-Making," in Robert Gilpin and Christopher Wright, eds., Scientists and National Policy-Making (New York: Columbia University Press, 1964), pp. 3-6.

[38] Philip J. Gummett and Geoffrey L. Price, "An Approach to the Central Planning of British Science: The Formation of the Advisory Council on Scientific Policy," Minerva, Vol. XV, No. 2 (Summer 1977), pp. 120-143; Norman J. Vig, Science and Technology in British Politics (Oxford: Pergamon Press, 1968); and his "Policies for Science and Technology in Great Britain; Postwar Development and Reassessment," in Long and Wright, op. cit., pp. 59-109.

Energy Commission in France in 1946;[39] the formation of the civilian Atomic Energy Commission (1946) and organization of the National Science Foundation (1950) in the United States;[40] and the subsequent preoccupation of governments, in general, to review their national science policies.[41]

The expanding role of science and technology in government, as shown by the preceding historical survey, has been motivated largely by the desire among states to maintain economic development and military superiority. With the emergence of the Cold War and space exploration, national prestige has been added to these two goals of science

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[39] Robert G. Gilpin, Jr., "Science, Technology, and French Independence," in Long and Wright, op. cit., pp. 113-132;and his France in the Age of the Scientific State, op. cit., chs. 6-7.

[40] The creation of the National Science Foundation was recommended by Vannevar Bush in his report to President Harry S. Truman, entitled Science: The Endless Frontier. For a personal account of his role in the establishment of the NSF, see Vannevar Bush, Pieces of the Action (New York: William Morrow & Co., Inc., 1970), pp. 63-66. On the NSF, see Dorothy Schaffter, The National Science Foundation (New York: Frederick A. Praeger, 1969), pp. 7-13.

[41] In Canada, a Special Senate Committee headed by Senator Maurice Lamontagne undertook an examination of past and present science policies in 1967. The Committee's findings and recommendations are embodied in its report, A Science Policy for Canada; Vols. 1 & 2 (Ottawa: Queen's Printer 1970 and 1972). Reactions to Vol. 1 of the Report showed that the question of planning versus freedom in science remained an important issue in Canada. See, for example, Harry E. Gunning, "The Lamontagne Report: a Simplistic Approach to a Complex Problem," Science Forum, Vol. 4, No. 2 (April 1971), pp. 7-8; "Senator Lamontagne replies to the critics of the Senate Science Report," Science Forum, Vol. 4, No. 3 (June 1971), pp. 9-13.

policy among the industrial states.[42] The continuing importance attached to science policy among the industrialized states can be seen from the periodic ministerial discussions, conferences on science policy and surveys of national government organization and resources devoted to scientific research and development undertaken by the member states of the Organization for Economic Co-operation and Development (OECD) since the 1960s.[43]

Science Policy and Developing Countries

Concern with science policy has also spread to the less developed countries, largely as a result of the efforts of the United Nations and its specialized agency, UNESCO. In 1963, for example, the UN sponsored a Conference on Science and Technology for Development which discussed ways by which science and technology could be utilized for the benefit

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[42]As Congressman Emilio Q. Daddario put it, for example: "Science policy as defined by Congress has two distinct aspects. First, there is the body of policy for science. This policy is to assure the continuing health of science in the United States in terms of trained manpower, facilities, management and organizations, funding channels, information exchange, etc. The objective is to establish United States science as preeminent throughout the world and to enable the exploration of areas of promise as they are perceived." See Emilio Q. Daddario, "Congress and Science Policy," in Arthur B. Bronwell, ed., Science and Technology in the World of the Future (New York: John Wiley & Sons, 1970), p. 226.

[43]See, for example, OECD, Ministers Talk About Science; A Report on the Ministerial Meeting on Science held at OECD, Paris, October 1963 (Paris: OECD, 1965); Government and Allocation of Resources to Science and Fundamental Research and the Policies of Governments; Background Reports for the Ministerial Meeting on Science, January 1966 (Paris: OECD, 1966); OECD, Problems of Science Policy;Report of a Seminar held at Jouy-en-Josas in February 1967 (Paris:OECD, 1968); OECD, Science, Growth and Society; A New Perspective (Paris: OECD, 1971); OECD, Science and Technology in the People's Republic of China; a Study based on a Seminar held in Paris in September 1976 (Paris: OECD, 1977); and OECD, Reviews of National Science Policy: Belgium, 1966; France, 1967; United Kingdom-Germany, 1967; Japan, 1967; United States, 1968; Canada, 1969; Italy, 1969; Norway, 1971; Austria, 1971; and others.

of less developed countries without unduly disrupting these societies.[44] UNESCO, since 1965, has also been publishing reports on the organization of scientific research and policies of its member states.[45] These country surveys are ostensibly designed to assist member states in determining their scientific and technological potential and priorities for development.[46] In 1968, UNESCO convened a Conference in New Delhi, India, on the Application of Science and Technology to the Development of Asia. The goal of scientific autonomy among the new nations was considered at the Conference as vital to their independent development. As its Report stated:

> The progress of a country depends on its capacity to identify, resolve and decide upon the scientific and technical problems which confront it at the successive stages of economic and social development. This is particularly relevant to the change-over from the traditional industries to the new forms of production, and to the integration of modern techniques into the national production system. This process cannot take place in a country that has not attained a certain degree of advancement in science, which must hence be regarded as an essential prerequisite for any genuine national independence.
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> From this viewpoint, the aim of the government policy in science and technology will be to procure an endogenous social and economic development supported by the nation's

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[44]Among the topics discussed were "Education and Training" and "Science and Planning." See Science and Technology for Development; Report on the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas (New York: United Nations, 1963), Vols. VI and VII.

[45]These reports form part of the UNESCO series, "Science Policy Studies and Documents" (SPSD) which has now reached report no. 41. The first report was Science Policy and Organization of Research in Belgium, SPSD, No. 1 (Paris: UNESCO, 1965).

[46]As a guide to these surveys, UNESCO has issued a Manual for Surveying National Scientific and Technological Potential; Collection and Processing of Data, Management and "R & D" System; Science Policy Studies and Documents, No. 15 (Paris: UNESCO, 1970); and Method for Priority Determination in Science and Technology; UNESCO/UNACAST Surveys of Institutional Needs of Developing Countries in the Field of Science and Technology; Science Policy Studies and Documents, No. 40 (Paris: UNESCO, 1978).

> own scientific and technological community and to reach this goal, international and regional cooperation in science is a vital element.[47]

The foregoing view on the role of science and technology policy in the development of new states has also been expressed by Edward Shils, thus:

> For underdeveloped countries, many or most of the problems of scientific policy are the same as those of the advanced countries. There is one very important exception. This is the establishment of a scientific tradition, that is, the establishment of beliefs and orientations that heighten and maintain sensibilities and motivations that prompt the selection of important and appropriate problems for investigation and suggest the approach toward them in ways that permit their fruitful solution. Countries in which science is well established may take this for granted.... it is an obvious task of science policy in these (underdeveloped) countries to make the arrangements that will foster the establishment of such a tradition.[48]

In a similar vein, Stevan Dedijer emphasized that:

> National development requires a large and continuous production of scientific results; the importation of foreign specialists to produce them is politically and economically intolerable as a long-term arrangement. The development of a national research potential, i.e. qualified scientists, scientific institutions and equipment and a scientific culture within those circles must be created in order to carry out other national policies with any degree of effectiveness. The development of this potential must be regarded from the first not as a luxury but as an inseparable part of the general programme of development. Hence, a policy for the development and the use of science must be from the start an integral part of the national policy. Science policy must be as important part of the national development policy as economic and educational policy....to neglect a planned and vigorous

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[47] UNESCO, Science and Technology in Asian Development; Conference on the Application of Science and Technology to the Development of Asia, New Delhi, August 1968 (Paris: UNESCO, 1970), pp. 103-104.

[48] Edward Shils, ed., Criteria for Scientific Development: Public Policy and National Goals (Cambridge, Mass.: The M.I.T. Press, 1968), pp. xiii-xiv.

> development of indigenous research in the physical, life and social sciences endangers the whole process of development.[49]

The preceding views emphasize that developing countries must build up their own scientific and technological capability as tools for socio-economic development and genuine national independence. Elsewhere in the literature on science policy it has been pointed out that scientific and technological capability is particularly needed by a developing country, in the first place, to be able to survey and assess its own natural resources, and undertake their exploitation and development in the light of the conditions and needs of the society, and, secondly, to effectively acquire, absorb, and adapt existing science and technology from other countries for its own purposes.[50] Thus it has been argued that a developing country's national science policy "should be a reflection of long-term national goals and objectives, and the overall economic and social development plan designed to achieve these aims."[51] Science planning, therefore, needs to become an integral part of overall development planning.[52]

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[49] Stevan Dedijer, "Underdeveloped Science in Underdeveloped Countries," in Shils, ibid., p. 146.

[50] Charles Cooper, "Science and Underdeveloped Countries," in OECD, Problems of Science Policy, op. cit., pp. 155-162; Claire Nader and A.B. Zahlan, eds., Science and Technology in Developing Countries; Proceedings of a Conference Held at the American University of Beirut, Lebanon, 27 November to 2 December 1967 (Cambridge: Cambridge University Press, 1969), p. xvi.

[51] Graham Jones, The Role of Science and Technology in Developing Countries (Oxford: Oxford University Press, 1971), p. 36.

[52] Dwight Waldo, "Planning and Administration for Viable Policies: The Perspective of Official Responsibility," in Nader and Zahlan, op. cit., pp. 402-405.

Behind the arguments linking scientific and technological capability with the independence of developing states is the recognition that modern science and technology developed within certain social, economic and political milieux. It is, therefore, unwise for developing countries to rely completely on industrialized states for their scientific and technical needs. As Waldo pointed out:

> the developed nations are nations, and while nations (and certainly persons and groups therein) are sometimes capable of acts of disinterested altruism towards other nations and nationals, this is not their distinguishing feature; and the truth is that much of the aid that is given, scientific and technical included, is given in an atmosphere of competition, rivalry and potential hostility. Science ... is presumed to have important international characteristics and even supranational potentials and tendencies. But even the most abstract and theoretical sciences are also embedded in particular languages and cultures, from which they cannot wholly be divorced: there is a giver as well as a gift and gifts notoriously create relationships. (That the 'gift' was purchased may be important but does not necessarily nullify the point). Technology is even less divorced from particular cultures and national interests.[53]

The problem of dependence or autonomy in science and technology for developing countries is closely tied up with the question of political and economic dependence or autonomy of the new states. This has continued to be a salient issue in the recently held United Nations Conference on Science and Technology for Development which was held in Vienna, Austria.[54]

From a scientist's point of view, developing countries need to build up their own scientific and technological capability since they

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[53] Ibid., p. 401.

[54] "Dependence or Autonomy: UNCSTD's Hidden Agenda," Nature, Vol. 280 (16 August 1979), pp. 525-526; "UNCSTD: What's to be Done? 14 Experts Comment," Nature, ibid., pp. 527-532.

"have as much to give to science as they have to take from it."[55] This argument is based on the recognition that scientists in developing countries, by virtue of their being in different locations in the world and working in different environments, are in a better position than scientists in developed countries to study certain problems in science, for example, tropical diseases, agriculture, and the like. The fund of scientific and technological knowledge can thus be enriched for the benefit of mankind through international scientific cooperation and exchange.

Socioeconomic Environment of Science in the Philippines

In order to have a better perspective of the goals and problems of science policy in the Philippines, a brief survey of the country's socioeconomic conditions is necessary. Further details are to be found in Appendix A.

Geography and Natural Resources. The Philippines is an archipelago of some 7,100 islands with a land area of 115,830 square miles (300,000 square kilometers). It is bounded on the west and north by the South China Sea, on the east by the Pacific Ocean and on the south by the Celebes Sea. The northernmost island is about 65 miles south of Taiwan and the southernmost island is about 30 miles north of Borneo.

The two largest islands of the archipelago are Luzon and Mindanao, with eleven of the largest islands constituting 95 per cent of the total area. The islands are located within the circum-Pacific seismic belt and sit on a series of stress lines. Numerous faulting and folding along these lines have caused earthquakes and volcanic activities, some of which had been catastrophic in certain areas of the country. Because of these extensive earth movements over geological time, mountain

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[55] Bernal, op. cit., p. xxix.

ranges developed dividing the islands along a general north-south alignment. About 65 per cent of the islands are mountainous or upland.

Much of the country also lies within the path of tropical cyclones. The most destructive of these are the typhoons which have center wind velocities of more than 118 kilometers per hour. The frequency of these typhoons in the country increases generally from south to north. Only southern Mindanao is relatively free of their havoc. More than half of these typhoons usually occur during the month of June to October.[56] Tropical cyclones and local thunderstorms account for much of the regional variation in rainfall in the country. Some areas have distinct wet and dry seasons while others have an even distribution of rainfall throughout the year. The average annual rainfall in the country is about 120 inches but ranges from 35 to 216 inches in different parts. The average temperatures for the archipelago is 26 to 28 degrees centigrade annually.

The natural resources of the Philippines consist of agricultural land, forests, minerals, fisheries and aquatic resources. In 1975, most of the disposable land (82.9 per cent) was utilized for agricultural production, both food and export crops. About one third of this was used for the production of rice. The rest of the cultivated land was used for the production of corn, coconut, sugar cane, fruits such as bananas, mangoes, pineapple and citrus, vegetables, abaca, tobacco,

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[56]Records kept by the Philippine Atmospheric, Geophysical and Astronominal Services Administration from 1948 to 1976 show an annual average of 19 tropical cyclones in the Philippines. The minimum recorded for one year (1975) was 12 while the maximum was 32 (1964). An average of 10 cyclones reach typhoon proportions. See Republic of the Philippines, National Economic and Development Authority, <u>1977 Philippine Statistical Yearbook</u> (Manila: 1977), pp. 244-247.

cotton, rubber and other crops.[57]

About 77.4 per cent of the country's timberland is considered commercial forest. Logs and lumber have been one of the top ten export earners since 1949. The country's mineral resources include precious metals such as gold, silver,platinum and palladium, base metals such as copper, iron ore, nickle, chromite ore, molybdenum, pyrite cinders ore, quicksilver (mercury) and zinc and non-metallics such as gypsum, coal, silica-sand,gravel and sand, and others. Mining and quarrying contributed 2.1 per cent to total gross domestic product in 1975.

The Philippines' geographical location and physical characteristics make it a rich fishing ground. The total marine fishery resources consisting of territorial and insular waters cover an area of about 1.6 million square miles or 14 times the land area of the country.

The Population and Its Characteristics. As of May 1975, the estimated population of the Philippines was 41,831,045 with an average annual rate of increase of 2.7 per cent. This was 117 per cent more than the 1949 census which recorded 19,234,182 persons. In less than three decades, therefore, the country's population has more than doubled. Assuming constant fertility and slow decline in mortality, the population is projected to reach 70,521,000 in 1990 and 97,257,000 by the year 2000.[58]

The country's population is still predominantly rural. About 33 per cent of the people lived in the urban areas and 67 per cent lived

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[57]Disposable land totaled 12,975,861 hectares. See ibid., Tables 6.8 and 6.9, pp. 262-263; Table 5.2, pp. 208-217.

[58]Ibid., pp. 38-39.

in the rural areas according to the 1970 Census.[59] The Philippines has a relatively young population with over half (56.8 per cent) of the total in 1970 belonging to the age group of 19 years old and below. Those belonging to the age group 20 to 34 years old made up an additional 20.9 per cent of the total population.

Approximately two thirds of the employed labor force (10,073 thousand) lived in the rural areas. A majority of the urban workers, 90.6 per cent (4,027 thousand), were employed in nonagricultural industries. Most of these were in commerce (22.2 per cent), government, community, business and recreational services (20.1 per cent), and manufacturing (17.6 per cent). Only 9.4 per cent were in agriculture. In contrast, 73.3 per cent of employed workers in the rural areas were engaged in agriculture, forestry, hunting and fishing. About 37 per cent of all the employed labor force in nonagricultural industries (2,561 thousand) were found in Region IV, i.e. Metropolitan Manila Area and the Southern Tagalog provinces.[60]

Seventy-six percent of the people were literate. Literacy rate in the urban areas was higher, 86.6 per cent, compared with 71.4 per cent

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[59] As defined by the National Census and Statistics Office, urban areas in their entirety comprise all cities and municipalities which have a population density of at least 1,000 persons per square kilometer; poblaciones or central districts of municipalities and cities which have a population density of at least 500 persons per sq. km., and/or poblaciones or central districts which, regardless of population size, have a street pattern, at least six establishments, and a town hall or a church, a public plaza, a public building like a school, a hospital, a puericulture center, or a library. Rural areas comprise all poblaciones or central districts and all barrios that do not meet the requirements for classification as urban. See ibid., p. 23.

[60] Ibid., pp. 35-68; National Census and Statistics Office, "Labor Force, August 1975," National Sample Survey of Households Bulletin, Series No. 46 (Manila: July 1976), pp. xvii, 2-3.

in the rural areas.

Income Distribution. There is a great disparity in the distribution of income within the country. In 1956-57, the lowest 20 per cent of families (classified according to income received) got 4.5 per cent of total family income. The top 20 per cent of families received 55.1 per cent of total income. There was little change in the distribution of family income in 1971. The lowest 20 per cent of families received 3.6 per cent of total family income while the top 20 per cent received 54 per cent of total family income.

The Economy. Philippine economy is still predominantly agricultural in character with over one fourth of the net domestic product being contributed by agriculture, fishery and forestry. The relative contribution of this sector to net domestic product (NDP), however, has been declining since 1960. In 1960, agriculture, fishery and forestry contributed 34.8 per cent to total NDP. This went down to 29.7 per cent of total NDP in 1974. The average growth rate of this sector was 7.2 per cent in 1950-55; 5.5 per cent in 1960-65 and 1.9 per cent in 1970-74.

By contrast, the industrial sector's contribution, which includes mining and quarrying, manufacturing and construction, to NDP has been increasing from 21.9 per cent in 1960 to 26.4 per cent in 1974.

The service sector (transport, communications and storage, commerce and services) contributed 43.3 per cent in 1960 to total NDP and 43.9 per cent in 1974. Commerce registered a 13.8 per cent contribution to total NDP in 1951-55 and 15.8 per cent in 1971-74. Its average growth rate in 1950-55 was 10.4 per cent and was 5.8 per cent in 1974-75.

Over the fourteen-year period, gross national product grew at an average rate of [illegible] per cent in 1950-55, 5.3 per cent in 1960-65 and

6.1 per cent for 1970-74.[61]

The country's ten principal exports since 1950 have been composed mainly of agricultural, forest and mineral products. There has been an increasing trend in exporting more of these products in semi-processed form rather than as raw materials.

The total value of imports into the country has generally exceeded exports. Classified according to end use, imports of consumer goods has declined from 36.8 per cent of the total for the country in 1949 to 15.9 per cent in 1975. Imports of capital goods has gone up from 13.8 per cent of the national total in 1949 to 33.2 per cent in 1975. There has been a slight increase in the imports of raw materials and intermediate goods from 49.4 per cent in 1949 to 50.8 per cent in 1975.

Agriculture, forestry, hunting and fishing has continued to provide employment for over half of all the employed labor force in the country, 53.5 per cent in 1975. The employed labor force in manufacturing establishments was 11.4 per cent in 1975. Commerce employed 11.2 per cent. Government, commercial, business and recreational services provided work for 9.2 per cent in the same year.

Professional and technical workers comprised 5.5 per cent of the employed labor force in 1975.

The number of manufacturing establishments has been growing. Manufacturing establishments for food (numbering 3,833 or 28.8 per cent of the total) and footwear and wearing apparel (numbering 3,879 or 29.1

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[61] Gonzalo M. Jurado, "Industrialization and Trade", in Jose Encarnacion, Jr., *et al*, *Philippine Economic Problems in Perspective* (Quezon City: Institute of Economic Development and Research, School of Economics, University of the Philippines, 1976), pp. 302-303.

per cent of the total) made up the largest group in 1974. Establishments producing machinery and chemicals made up a mere 2.2 per cent and 2.1 per cent, respectively, of the total.

What emerges from this summary is the gradual modernization of the Philippine economy. This is shown by the growth of the manufacturing sector vis-a-vis the agricultural sector, the increasing urbanization of the country and the relative decline of employment in agriculture, forestry, hunting and fishing compared with other industries. The country has also achieved self-sufficiency in the production of rice, the main staple of 80 per cent of the population. This was accomplished through the Masagana 99 program which was started in 1973. A national rice production program, Masagana 99 involved the introduction of high yielding varieties of rice, coupled with the dissemination of information on scientific farming, double cropping, a land reform program and extensive credit assistance to farmers. In the past years, rice production was highly dependent on the vagaries of weather and the absence of pests and diseases. For this reason, self-sufficiency in rice was a key issue in Philippine politics and elections.

The country's continuing reliance on its traditional agricultural exports leaves its economy vulnerable to the vicissitudes of the world market. The discovery of synthetic fibers, for example, led to a slump in the demand and prices for abaca. The country's rate of economic growth is also greatly affected by economic conditions of the western world because of its growing foreign trade. Inflation and recession in the capitalist world in 1973 has had a great impact on the growth rate of the gross national product. It fell from a high of 9.8 per cent in 1973 to 5.9 per cent in 1974. The sudden increase in oil prices more than offset the country's export earnings for that year.

Despite the progress that has been achieved in the past few years, the Philippines is still faced with problems of high population growth, highly unequal distribution of income, low standards of living in the rural areas, unemployment and underemployment, inflation and the rising levels of expectations from the general population as a consequence of the progress in the means of mass communications.

The foregoing socioeconomic data on the Philippines have serious implications for government policy, particularly in the area of science and technology. The rapid population growth highlights the urgency of accelerating agricultural production and promoting self-sufficiency in food supply. For science and technology, this points to the need for further research on agriculture, forestry, fisheries and the exploitation of other natural resources, nutrition and food processing and the development of technology appropriate to the rural setting in these fields. Rapid population growth, moreover, shows the absolute necessity of generating more employment opportunities in the country. Even more basic is an effective family planning program. Because of the characteristics of the Philippine labor force, its rapid growth, and the predominance of unskilled and semi-skilled workers, industries that are labor rather than capital intensive in nature will have to be developed and encouraged. As the economy is mainly agricultural, such industries will have to be geared to the processing and exploitation of indigenous crops and raw materials. A critical factor in the country's present development efforts is the absence of self-sufficiency in energy supplies, necessitating the intensive search for fossil fuels, tapping existing hydro and geothermal resources, and further research and development on alternative energy sources. The education of scientists and engineers in the country will have to be oriented to these social needs and economic conditions.

Goals of the Government

The Philippine government has tried, since independence, to tackle problems of economic development with a series of economic plans. The earliest plans were drafted with the assistance of American advisers. Understandably, many of the concepts and approaches that they used to analyze the Philippine situation were ill-suited to its conditions. The early plans were generally based on the theory that economic growth could be induced by developing the modern, industrial sector of the economy. It was anticipated that growth achieved in this manner would ultimately trickle down to the traditional rural sector and stimulate its growth through a multiplier effect. The erratic economic record during the first decade of independence belied the expectations of the early economic planners. Consequently, government plans had to be re-oriented to integrate social aspects of economic development. From the 1960s, such plans included programs for the development of education, promotion of health of the population, skills training programs, improving agricultural extension and agricultural credit, and community development. A landmark in socioeconomic development was the enactment of the Agricultural Land Reform Code in 1963 which abolished share-cropping tenancy and created leasehold farmers.[62] These farmers would eventually become owners of family-size farms and would be extended government technical and credit assistance. The full implementation of agrarian reform was expected to increase agricultural productivity

[62] Republic Act No. 3844, 22 June 1963.

and redirect investments in landholdings to provide the much needed capital for industrialization. It was thus expected to bring about a restructuring of the economy.

The worsening peace and order situation, inflation and the disastrous floods of 1972 brought about a declaration of Martial Law and the dismantling of the legislative body. The new political order has stepped up the implementation of agrarian reforms and agricultural production. Along with this, a reorganization of the Executive branch of the government has been carried out. New development plans have been designed. The Four Year Development Plan for 1974-77 set the government's goals as the promotion of social development; expansion of employment opportunity; the achievement of a more equitable distribution of income and wealth; acceleration of the pace of economic growth; the promotion of regional development and industrialization; and the maintenance of price stability. Components of the Plan's social development program include the reduction of population growth through a family planning program; improvement of health and nutrition of the population; education and manpower development, including a science development program; a housing program; expansion of employment opportunities; social welfare services; and community development projects. The development plan is, therefore, a comprehensive one, recognizing the interdependence of the various sectors and economic activities in the attainment of national goals and objectives.

The Five-Year Development Plan (1978-82) and the Long-Term Development Plan for the year 2000 are geared towards continuing the efforts to achieve the goals of the preceding plan. The national aspirations for the year 2000 include political stability, self-reliance in basic needs, a high level of industrialization, rural and regional development and resource adequacy and development.[63]

The Problem: Focus of the Study

The Philippines is one of the developing countries which is attempting to utilize the benefits of science and technology to achieve its goal of accelerated socioeconomic progress. A predominantly agricultural country, it aims not only at the improvement of its agricultural productivity and the systematic exploitation of its natural resources, but also the development of its industrial base, and the improvement of the general health and welfare of the people. To achieve these goals, the Philippine Government has to carefully plan the systematic allocation and use of its resources, material as well as human. The adoption of policies to foster the development of science and technology is an important aspect of such planning.

In the light of the earlier discussion on science policy, this study looks into the policies adopted by the Philippine Government to promote the growth of science and technology, particularly in regard to the education and training of scientists and engineers. The education of scientists and engineers is a vital component of science policy. Scientists and engineers form part of a nation's human resources, which in Harbison's view,is its "ultimate basis" for its wealth.[64] The Philippines needs these highly-trained individuals to advance basic or

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[63]Republic of the Philippines, National Economic and Development Authority, Long-Term and Five-Year (1978-82) Development Plans; Draft Summary (Manila: 1977), pp. 1.1 to 1.6.

[64]Frederick H. Harbison, Human Resources as the Wealth of Nations (New York: Oxford University Press, 1973), p. 3.

fundamental knowledge about its natural resources and environment upon which applied research will be based. Such persons are also indispensable for their ability to innovate both in the transfer of technology as well as in the utilization of relevant scientific knowledge from other countries for the achievement of national goals. In order to be of maximum benefit to the country, policies towards the education and training of scientists and engineers must thus be related to existing conditions of Philippine society and also to future aspirations. This is necessary because, although

> a vast amount of scientific knowledge is continually being generated by the world's scientists, the only persons capable of selecting from the flood of information what is useful for local purposes are practicing scientists. They alone can comprehend what is being done and keep abreast of scientific advances. However, they can perform that service only if they are familiar with local needs and conditions. Scientists isolated from their society, however competent they may be, can contribute little to the development effort.
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> The same is true in importing technology.[65]

The education and training of scientists and engineers in the Philippines began during the Spanish regime and was expanded during the American period. The structure of science education and training was closely modeled after those of the colonial powers and geared towards the needs of the colonial government. With the achievement of political independence in 1946, following the devastation of war and Japanese occupation, the Philippines had to face the problems of post-World War II reconstruction as well as long-run socioeconomic development. It was then in a position to formulate its own national plans and policies. This study, therefore, examines the policies of the Government of the

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[65] Hal S. Kibbey, "Foreword" in Michael J. Moravcsik, Science Development: The Building of Science in Less Developed Countries (Bloomington: Indiana University, PASITAM, 1974), p. x.

Philippines since 1946, in respect to the education and training of scientists and engineers and the relation of these policies to its socio-economic development plans and programs.

The definition of the term scientist and engineer basically follows that used by the UNESCO, that is:

> Any person who has received scientific or technical training in the exact and natural sciences, engineering and agricultural sciences as specified below:
>
> 1. completed education at the third level leading to an academic degree.
>
> 2. completed third-level non-university education or training which does not lead to an academic degree but is nationally recognized as qualifying for a professional career.
>
> 3. training and professional experience which is nationally recognized (e.g. membership in professional societies, professional certificate or license, as being equivalent to the formal education indicated in (1) and (2)...[66]

The fields of specialization covered by the study include the natural sciences, engineering and technology, and agriculture. The natural sciences encompass the life sciences such as biochemistry, biology, botany, microbiology, zoology and related disciplines, and the physical sciences such as astronomy, chemistry, geology, mathematics, meteorology, physics and other related subjects. Engineering and technology cover engineering proper such as chemical, civil, electrical and mechanical engineering and specializations within these fields; applied sciences such as industrial chemistry; and specialized technologies or interdisciplinary fields such as industrial engineering, metallurgy, mining, marine, systems, and textiles engineering, and others. Under agriculture are disciplines such as agricultural engineering, agro-

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[66]UNESCO, Scientists Abroad; A Study of the International Movement of Persons in Science and Technology (Paris: UNESCO, 1971), p. 41.

nomy, animal husbandry, dairying science, fisheries science, food processing science, forestry, horticulture, veterinary medicine and related specializations.

While the definition of scientist does not usually include practising physicians (though it does, of course, include medical researchers), this study also looks at the education and training of these professionals in the Philippines. The decision to include them has been influenced by the current debate on the need to restructure the medical curriculum, and by the fact that, as will be seen in Chapter 2, physicians constitute the largest group of science-trained professionals which has been lost through emigration to other countries, mainly to the United States and Canada.

As a starting point of the study,[67] Chapter 2 looks at the problems of underemployment and unemployment of scientists and engineers and their "brain drain" or loss to other countries. The problems of unemployment/underemployment and brain drain are viewed as symptoms of more basic issues arising from policies for scientific education and training.

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[67] Data-gathering for the study involved library research on laws, published materials, documents, newspaper clippings, interviews with knowledgeable officials in government, universities and colleges and interviews/questionnaires administered to selected groups of scientists, engineers and physicians.

Chapter II

Underemployment and Unemployment of Scientists and Engineers

Underemployment and unemployment are problems which have continually beset the Philippines. Statistics show that from 1960 to 1964, unemployment rates in the country averaged 6.0 per cent yearly, representing 610,000 persons in the labor force being without work each year. From 1965 to 1969, the average annual rate of unemployment rose to 7.1 per cent with the number of persons in the labor force without work averaging 821,000 yearly. Unemployment rates dropped to an annual average of 4.6 per cent from 1971 to 1975, with about 641,200 persons each year without jobs.[1]

The unemployed in the Philippines include a large number of highly educated workers, i.e. those who possess college degrees or diplomas. This situation is usually attributed to the underdeveloped state of the country's economy, particularly its industrial sector, as well as the large number of college graduates produced annually by the educational system which is greater than the economy can absorb. For example, in the ten-year period from 1951-52 to 1960-61, a total of 371,845 college graduates from private colleges in all fields of studies, were added to

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[1]Republic of the Philippines, National Economic and Development Authority, 1977 Philippine Statistical Yearbook (Manila: March 1977), Table 1.13, p. 66. From 1965-69, the average annual rate of unemployment in the rural areas was 6 per cent and dropped to an average annual rate of 3 per cent from 1971-75, with a low of 2 per cent unemployment in 1974. This probably reflects the combined effects of various government programs such as, for example, land reform, agricultural loans and extension of technical assistance in connection with the rice production (Masagana 99) program, expansion of cottage industries and rural development projects.

the country's labor force. This accounted for 90 per cent of the output of all colleges/universities in the Philippines. From 1961-62 to 1970-71, the increase in the country's educated manpower totaled 727,731 graduates from the private colleges. This was nearly twice the number for the previous ten-year period. From 1971-72 to 1974-75, private colleges added 336,000 graduates to the labor force.[2]

Unemployment rates for persons with college education lasting four or more years tend to be slightly lower than the average unemployment rate for the entire labor force. Available data for 1961, 1965 and 1968 show that the unemployment rates for this group of college-educated manpower were 7.9 per cent, 5.8 per cent and 7.2. per cent, respectively. The corresponding average unemployment rates for the entire labor force were 8.5 per cent, 6.1 per cent, and 7.8 per cent. Table II-1 shows the unemployment rate in the Philippines, according to level of educational attainment, in 1961, 1965 and 1968.

Persons with four or more years of college education made up 3.2 per cent of the 9,395,000 employed persons in 1961. In 1965, they comprised 4.9 per cent of the 10,101,000 employed workers. In 1961, persons with four or more years of college education accounted for 56.6 per cent of all professional, technical and related workers. In 1965, these employed college graduates constituted 79 per cent of the 375,000 professional, technical and related workers in the country. Employed scientists and engineers are usually included in this category

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[2] _Ibid._, Table 15.5, pp. 564-565. About 90 per cent of all college/university graduates in the country each year were from private colleges up to 1970. Since 1971-72, this proportion decreased gradually reaching 84.5 per cent in 1975-76. The share of the state colleges and universities has increased from 10 per cent to 13.5 per cent.

Table II-1
Unemployment Rates by Educational Attainment
1961, 1965 and 1968

Educational Attainment	May 1961	October 1965	May 1968
No grade completed	4.0%	2.7%	4.4%
Grades I-IV	5.6	3.8	4.5
Grades V-VI	9.4	7.1	6.8
High School, 1-3 years	12.6	9.4	13.7
High School graduate	18.1	11.3	15.3
College, 1-3 years	18.7	15.3	17.4
College, 4 or more years	7.9	5.8	7.2
Average	8.5%	6.1%	7.8%

Source: The Bureau of Census and Statistics Survey of Households Bulletins compiled by J. Encarnacion, G.A. Tagunicar and R.L. Tidalgo, "Unemployment and Underemployment," in Jose Encarnacion, Jr. et al, Philippine Economic Problems in Perspective (Quezon City: University of the Philippines, School of Economics, Institute of Economic Development and Research, 1976), Table 5.13, p. 170.

of workers. Table II-2 gives the distribution of employed persons with college education as a proportion of all employed persons, by major occupation group in 1961 and 1965.

Extent of the Problem

It is generally accepted that the underemployment and unemployment of persons with college education has been a major cause of the emigration or "brain drain" of a large number of Filipino professionals to other countries, chiefly the United States of America and Canada. The brain drain became especially noticeable in the late 1960s and has continued into the 1970s. The Philippine government has shown increasing concern about this problem, particularly the loss of qualified scientists, engineers and physicians, because of its long-run effect on the country's supply of highly-trained manpower.[3] These educated

[3]See, for example, "Government Acts to Win Back Filipino Scientists Abroad," Philippine News, 18-24 July 1974, p. 1; "Government Policy on Outflow of Doctors,Nurses Set," Bulletin Today, 2 November 1975, pp. 1,11; "Cite Moves to Cut Down 'Brain Drain'," Bulletin Today, 23 June 1977, pp. 1, 4.

Table II-2
Distribution of Employed Persons By Level of Education and By Major Occupation Group, 1961 and 1965

Level of Education	Total	Major Occupation Group: Professional, Technical and Related Workers	Proprietors, Managers & Adm. Officials	Clerical, Office and Related Workers	Salesmen & Related Workers	Farmers, Farm Laborers, Fishermen	Workers in Mining, Quarrying and Related Occupations	Workers in Operating Transport Occupations
May 1961								
Total number of employed persons	9,395,000	212,000	331,000	256,000	566,000	5,603,000	27,000	212,000
Per Cent Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per Cent Distribution								
Persons with 4-5 years college education	3.2	56.6	6.7	29.0	3.5	.2	-	.6
Persons with 1-3 years college education	3.0	29.9	5.6	25.6	3.8	.8	-	2.0
Elementary & High School	76.9	13.4	76.8	45.0	81.7	77.5	76.9	95.1
No Grade Completed	16.9	.2	10.9	.5	10.9	21.4	23.1	2.4
October 1965								
Total number of employed persons	10,101,000	375,000	432,000	352,000	675,000	5,670,000	14,000	272,000
Per Cent Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per Cent Distribution								
Persons with 4-5 years college education	4.9	79.0	9.7	27.8	3.5	.2	-	1.6
Persons with 1-3 years college education	3.2	12.0	5.0	26.9	5.7	.6	2.8	2.4
Elementary & High School	77.1	8.7	77.0	44.9	80.8	80.0	96.3	92.9
No Grade Completed	14.7	.2	8.4	.5	10.0	19.8	-	3.2

Source: Bureau of Census and Statistics, "Philippine Sample Survey of Households Series 12 and 19 on Labor Force and Educational Attainment, May 1961 and October 1965," in Edita Tan, "Causes of Unemployment of Educated Labor," Papers and Proceedings of the Workshop on Manpower and Human Resources, The Philippine Economic Journal, Number Twenty-Three, Vol. XII, Nos. 1 & 2 (1973), Table 4, pp. 612-613

Details may not add up to totals due to rounding.

manpower are considered as valuable resources in building the country's capability in advancing science and technology which is relevant to its development needs and in improving the quality of life for the majority of the population.

This chapter will examine the underemployment and unemployment of scientists, engineers and physicians in the Philippines with the following questions in mind. What is the extent of underemployment/ unemployment? Is there a regional maldistribution of science professionals in the country and, if so, how significant is it? What is the actual extent of the "brain drain"? In the context of the country's various needs, how far can these really be considered problems? The answers to these questions will provide us with an initial focus for an examination of the central concern of this study, namely, science policy in the Philippines in respect to the education and training of scientists and engineers. Such policy ultimately influences the direction of the development of Philippine science, science that is oriented to the peculiar ecological conditions and socioeconomic needs of the country. More specifically, science policy in respect to the education and training of scientists and engineers should ensure the availability of qualified manpower to undertake new scientific research or apply existing scientific and technological knowledge in the exploration and development of Philippine natural resources, the diversification and improvement of agricultural production, the establishment of agro-industrial enterprises, the improvement of the nutrition, health and welfare of the population and the achievement of other national development goals.

While there is up-to-date information on the general employment and unemployment situation of the Philippine labor force, there is very little published current data on the employment and unemployment of qualified scientists, engineers, physicians and other professionals in the country. Information on the unemployment of college educated persons in the labor force (such as that shown in Table II-1) does not usually provide any breakdown by fields of study. Nevertheless, some insights into the underemployment and unemployment of scientists, engineers and physicians can be derived from two studies made in 1961 and 1968.

The 1961 study, undertaken by the Office of Manpower Services of the Department of Labor, covered 194,000 persons with higher education. It showed that 73.5 per cent were employed. Engineering graduates made up 13,000 or 6.7 per cent of those with college degrees, 77.5 per cent of whom were employed. Those whose first degree was in medicine, dentistry, pharmacy and optometry comprised 15,000 or 7.7 per cent of the total with college degrees. Of this group, 77.1 per cent were employed. Graduates in agriculture and veterinary medicine totaled 4,000 or 2.1 per cent of those with college degrees, 70 per cent of whom were employed. Liberal arts graduates accounted for 4.6 per cent or 9,000 of the total number of degree holders studied. Included under this category were those who obtained the Bachelor of Science major in such fields as botany, chemistry, physics, mathematics, biological science, zoology, and others.[4] Only 45.0 per cent of these liberal arts

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[4] In Philippine universities and colleges, courses in the sciences are offered under the college of liberal arts. Hence, statistics on college/university graduates with Bachelor of Science degree are classified with the Bachelor of Arts graduates under the category of "liberal arts".

Table II-3
Employment Status of Persons with Higher Education
By Kind of First Degree Obtained, 1961

First Degree	Number	Per Cent	Per Cent Distribution by Status: Total	Employed	Unemployed	Not in the Labor Force
Liberal Arts	9,000	4.6	100.0	45.0	25.0	30.0
Commerce and Business Administration	41,000	21.1	100.0	78.4	13.4	8.2
Education	81,000	41.8	100.0	77.4	17.4	5.3
Engineering	13,000	6.7	100.0	77.5	16.1	6.5
Law	8,000	4.1	100.0	68.4	15.8	15.8
Agriculture and Veterinary Medicine	4,000	2.1	100.0	70.0	30.0	--
Medicine, Dentistry, Pharmacy and Optometry	15,000	7.7	100.0	77.1	5.7	17.1
Nursing and Midwifery	6,000	3.1	100.0	69.2	30.8	--
Collegiate Secretarial Course	9,000	4.6	100.0	45.0	45.0	10.0
Collegiate Technical Course	6,000	3.1	100.0	66.7	26.7	6.7
Others	2,000	1.0	100.0	60.0	40.0	--
Total	194,000	100.0	100.0	73.5	18.2	8.4

Source: Republic of the Philippines, Office of Manpower Services, Department of Labor, "Summary Report on Inquiry into Employment and Unemployment Among Those with High School or Higher Education," Table 85, p. 68, cited in Tan, op. cit., p. 610.

Details may not add up to totals due to rounding.

graduates were employed. Table II-3 shows the employment status in 1961 of persons with higher education, according to their first degree obtained.

The 1961 survey showed that the unemployment rate (i.e. the ratio of unemployed persons to the total number in the labor force) among scientists was highest for liberal arts graduates -- 35.7 per cent. Agriculture and veterinary medicine graduates had the second highest unemployment rate -- 30.0 per cent. Graduates of medicine, dentistry, pharmacy and optometry had the lowest unemployment rate for the science-

Table II-4
Unemployment and Employment Rates Among Persons with Higher Education, by Kind of First Degree Obtained, 1961

First Degree	Number	Per Cent	Unemployment Rate	Per Cent Employed: Total Employed	Full-Time	Part-Time
Liberal Arts	9,000	4.6	35.7%	45.0	35.0	10.0
Commerce and Business Administration	41,000	21.1	14.6	78.4	72.2	6.2
Education	81,000	41.8	18.4	77.4	70.0	7.4
Engineering	13,000	6.7	17.2	77.5	71.0	6.5
Law	8,000	4.1	18.8	68.4	57.9	10.5
Agriculture and Veterinary Medicine	4,000	2.1	30.0	70.0	40.0	30.0
Medicine, Dentistry, Pharmacy and Optometry	15,000	7.7	6.9	77.1	65.7	11.4
Nursing and Midwifery	6,000	3.1	30.8	69.2	53.8	15.4
Collegiate Secretarial Course	9,000	4.6	50.0	45.0	45.0	--
Collegiate Technical Course	6,000	3.1	28.6	66.7	46.7	20.0
Others	2,000	1.0	40.0	60.0	--	--
Total	194,000	100.0	19.9%	73.5	65.1	8.4

Source: Republic of the Philippines, Office of Manpower Services, Department of Labor, cited in Tan, *ibid*.

Details may not add up to totals due to rounding.

based professionals, i.e. 6.9 per cent. The study also revealed that even among those who were employed, there was a significant proportion of the graduates who were working only part-time, i.e. less than the standard 40 hours work per week. This group constitutes what is usually referred to in Philippine labor force statistics as the visibly underemployed.[5] Table II-4 presents the findings on the rate of unemployment among

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[5] "Employed persons at work reported as wanting additional work are considered underemployed -- *visibly underemployed* if they are part-time workers or *invisibly underemployed* if they are full-time workers." See Republic of the Philippines, National Census and Statistics Office, "Labor Force, August 1975," *National Sample Survey of Households Bulletin*, Series No. 46, (Manila: July 1976), p. xiv.

college graduates in 1961 and the proportion of those who were working full-time or part-time.

It can be seen from Table II-4 that the highest incidence of visible underemployment in 1961 was among graduates of agriculture and veterinary medicine. Of every 10 graduates in these two fields, seven were employed of whom three were working part-time. Slightly less than a fourth of the employed liberal arts graduates, i.e. 10 out of every 45 employed were holding part-time jobs. Among the graduates of medicine, dentistry, pharmacy and optometry, 77 out of 100 were employed, 11.4 of whom had part-time work. Employed engineering graduates had the lowest proportion of visible underemployment, i.e. for every 77.5 who were working, only 6.5 held part-time jobs.

The foregoing statistics showed that there was a significant proportion of unemployed and visibly underemployed graduates in the sciences and engineering in 1961. The extent of their underemployment tends to be somewhat underestimated since the study did not examine the situation of invisible underemployment, i.e. the number of persons working full-time but who wanted additional work. Nevertheless, the data provide useful insights into the under- and nonutilized scientific and technological manpower in the Philippines.

A further study in 1968 gives additional insights. Compared with 1961, graduates in engineering and technology in 1968 had a larger proportion of the unemployed degree holders -- 10.2 per cent of the unemployed graduates in all fields. Those in the natural, physical and related sciences made up 2.5 per cent of the unemployed college graduates as did those of the medical and paramedical sciences. Graduates in the natural, physical and related sciences comprised a mere 2.2 per cent of college-educated workers, those in the medical

Table II-5
Unemployment and Underemployment of High-Level Manpower, 1968

Field of Specialization	Distribution of Unemployed Per Cent	Distribution of Persons in the Labor Force in Per Cent	Rate of Visible and Invisible Underemployment	Unemployment Rate (Labor Force Concept)	Total Unemployment[1]
All Fields	100.0	100.0	17.8	7.1	7.3
Engineering and Technology	10.2	9.3	20.2	7.9	8.9
Natural, Physical and Related Sciences[2]	2.5	2.2	10.7	6.4	6.4
Medical and Paramedical Sciences[3]	2.5	8.6	16.0	1.6	2.8
Liberal Arts, Social Sciences, Business Administration and Education	85.7	79.8	18.1	7.8	8.4

Source: Corazon G. Mejia-Raymundo, "The Characteristics of and Extent of Unemployment Among the Philippine High-Level Manpower" (unpublished Master's Thesis submitted to the University of the Philippines, Population Institute, 1972), Table 5.5, p. 107.

Details may not add up to totals due to rounding.

[1]Total unemployment was arrived at by adding the full-time equivalent unemployment of the visibly underemployed to the percentage of the labor force not working at all.

[2]Includes agriculture, forestry, fishery, chemistry, home economics, food and nutrition.

[3]Includes medicine, dentistry, optometry, nursing, pharmacy.

sciences, 8.6 per cent and those in engineering made up 9.3 per cent. The rate of underemployment, visible and invisible, was highest among engineering and technology graduates, 20.2 per cent,and lowest for those in the natural, physical and related sciences, 10.7 per cent. Total unemployment, which combines the full-time equivalent unemployment of the visibly underemployed with the totally unemployed labor force, was also highest for engineering and technology graduates. Those in the medical and paramedical sciences had the lowest unemployment rate, whether measured in terms of the labor force concept (1.6 per cent) or in terms of total unemployment (2.8 per cent). Table II-5 summarizes the findings.

Compared with the total Philippine labor force in 1968, the unemployment rate for college graduates in all fields was slightly lower, 7.1 per cent, as against 7.9 per cent for all persons in the labor force. Total unemployment (full-time equivalent unemployment of the visibly underemployed and the percentage of the labor force not working at all) was also much lower for college graduates in all fields, 7.3 per cent compared with 11.5 per cent for the entire labor force.[6]

There is another aspect of underemployment of scientists and engineers which the foregoing data do not reveal. This is the problem of misdirected employment, involving a mismatch between educational preparation and the type of work or occupation actually held. This further adds to the under- or even nonutilization of scientific/technological training, hence, arguably, a waste of valuable human resources. However, this does not seem to be a waste if jobs are not available in science and technology. It may be speculated that misdirected employment is perhaps a symptom of an overproduction of scientists and engineers. Precise and up-to-date information on this aspect of underemployment of scientists and engineers is even more scarce than data on the visible and invisible underemployment of scientists and engineers. That this problem exists in the Philippines is revealed by a number of separate studies of scientific and technological manpower in 1965 and 1967.

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[6] "A Re-examination of the Underemployment Problem in the Philippines," Journal of Philippine Statistics, Vol. 23, No. 3 (Third Quarter 1972), Table B, p. xv.

In a survey of scientific and technological manpower employed in the national government sector which was undertaken in 1965, it was found that 13,154 persons in various government offices had college degrees or equivalent training in scientific and technological fields but held jobs which were nonscientific and nontechnical in nature.[7] Hence, their scientific and technological training were not being utilized. This group of workers comprised slightly less than 15 per cent of the 90,089 nonscientific and nontechnical workers in the national government sector and were more numerous than the 9,589 employed as scientists and engineers. Scientists and engineers constituted 8.6 per cent of the 111,034 workers in the national government who were covered by the survey. Those who were trained as scientists and engineers but held jobs which did not require such training made up

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[7]Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. I, The Report (Manila: National Science Development Board, 1966, mimeo.), p. 34. The Survey defined (p. 11) scientists as "all persons with at least a Bachelor's degree in a specific academic specialty in any of the physical, natural, mathematical, social sciences or engineering or other professionals engaged in engineering or scientific work. These include all persons engaged in scientific work which requires a knowledge of or training in physical, life or mathematical sciences equivalent at least to that required through completion of a 4-year college course with a major in these fields. These include all persons engaged in research, development, production, management, technical service, technical sales and other positions who have the equivalent of college training in the sciences and are required to use this training in their work. They do not include persons trained in the sciences but currently employed in positions not requiring such training." Similarly, it defined engineers (p. 12) as "all persons engaged in chemical, civil,electrical ... and other types of engineering work at a level which requires knowledge of, or training in, engineering equivalent at least to that required through completion of a 4-year college course with a major in this field... It does not include persons trained in engineering who are currently employed in jobs not requiring such training."

11.9 per cent of the national government workers studied.[8]

Further evidence of underemployment of scientists and engineers is provided by the study of scientific and technological manpower in higher educational institutions in the Philippines which was done in November 1967.[9] The survey found that of 13,224 scientists and engineers employed as academic personnel in a sample of Philippine colleges and universities, 1,900 or 14.4 per cent reported that their area of main activity was not in line with their field of specialization. For example, slightly less than a third of these (619 or 32.6 per cent) indicated that their main area of activity in their employment was in the social sciences. The data did not show precisely how their area of main activity differed from their field of specialization. Nevertheless, it is not unusual to find, for example, even among some of the large private universities and colleges, academic personnel who were trained as engineers teaching physics, mathematics or even business administration courses, pharmacy graduates teaching chemistry or the biological sciences, lawyers teaching political science or history, sociologists teaching geography and anthropology or even natural scientists also teaching social science courses.[10] The study also found that of 2,500 scientists and engineers employed as nonacademic personnel

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[8] Ibid., p. 60.

[9] University of the Philippines, Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations (Manila: National Science Development Board, 1968, mimeo.), Vol. I, The Report, Tables 2 and 7, pp. 19, 24; Vol. II: Statistical Tables, Tables A-2 and A-4.

[10] These examples are based on the writer's personal observation while teaching at one of the largest private universities in Manila from 1965 to 1970 and from the interviews with school officials while doing field research for this study.

in the colleges and universities surveyed, 1,045 or 41.8 per cent were working in areas which were not in line with their fields of specialization. Of this number, 38 or 3.6 per cent reported the social sciences as their area of main activity. Despite their limitations, these data suggest that, on the one hand, there is a lack of jobs in science and technology which could absorb, for example, engineering and pharmacy graduates. On the other hand, there seems to be a shortage of trained scientists in certain fields such as physics, mathematics, botany, zoology and other natural sciences.

The underutilization of engineers in the Philippines has also been noted by certain studies. This was, for example, brought to the attention of a study committee of the Department of Labor in 1968. A representative of the Personnel Management Association of the Philippines told the committee that "the present industrial structure cannot cope with the number of graduating students in engineering... graduates are hired for not really engineering positions.... Many engineers have taken in work as draftsmen, engineering assistants and technicians."[11] A survey of a number of private manufacturing enterprises made in 1970 also noted that in the absence of trained technicians, engineers were often assigned to perform the tasks and responsibilities of technicians.[12]

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[11] Republic of the Philippines, Department of Labor Study Committee, A Report on the Problem of the "Brain Drain" in the Philippines (Manila: September 1968), p. 13, quoted in M. L. Gupta, "Outflow of High-level Manpower from the Philippines, with Special Reference to the Period 1965-71," International Labour Review, Vol. 107, No. 2 (February 1973), p.182.

[12] Republic of the Philippines, Presidential Commission to Survey Philippine Education, Special Area Group for Vocational-Technical Education, Vocational-Technical Education in the Philippines (Quezon City: National Manpower and Youth Council, 1974), pp. 27-82.

These findings thus confirm the existence of underemployment of engineers, in the sense that they hold jobs which require less education and training than what they have obtained.

The foregoing discussion gives ample evidence of the existence of under- and unemployment of scientists, engineers and other highly-trained manpower in the Philippines. The precise extent of this problem, however, is difficult to ascertain. The periodic national sample surveys of households which is done by the National Census and Statistics Office (formerly the Bureau of Census and Statistics) do not usually provide details on the educational attainment and field of specialization of the nation's employed and unemployed labor force. Another reason for this difficulty was the absence of a national employment service in the Philippines until the early 1970s.[13] Regional manpower offices have existed for only a short time, and hence have not had much impact on providing precise information on this problem. Nevertheless, as has been shown above, existing studies taken together at least suggest the broad dimension of the problem. It is generally believed that the under- and unemployment of high-level manpower in the country is due to the apparent overproduction of college graduates in certain fields relative to the availability of appropriate employment which would readily absorb them. There is also the possibility that the under- and unemployment of these graduates, particularly in the sciences and engineering, is due to their maldistribution in the country. Hence, it is necessary also to look into the regional distribution of professional manpower in the Philippines.

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[13] Gupta, op. cit., p. 181.

Regional Distribution of Scientists and Engineers

The 1970 national census of population and housing showed that there were 1,083,760 persons in the Philippines with college degrees in all fields of specialization, about 3.0 per cent of the total population of 36,684,486. The proportion of persons with degrees in agriculture, engineering, medical and natural sciences was less than a fifth (18.9 per cent) of the total population with college degrees. Table II-6 shows the distribution of the Philippine population with college degrees by major field of study in urban and rural areas in 1970.[14]

It can be seen from Table II-6 that almost three quarters (72 per cent) of those with college degrees were in the urban areas in 1970. The population of the Philippines living in urban areas in that year was estimated at 10,140,000 or 27.6 per cent of total population. Persons living in the rural areas numbered 26,544,000 or 72.4 per cent of total population.[15] Those who specialized in the sciences and engineering were heavily concentrated in the country's urban areas. Of those specializing in the natural sciences, 10,485 or 83.1 per cent were in the urban areas. The comparative figures for the other scientific and technological fields in urban areas were: 68,342 or 79.2 per cent of those in engineering, 72,711 or 82.4 per cent of those in the medical sciences, and 10,144 or 60.2 per cent of those in agriculture. Among those in the

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[14]For the definition of urban and rural areas, see footnote 59, Chapter I, p. 24.

[15]This is slightly lower (16 per cent less) than the total urban population reported by the Bureau of Census and Statistics (now National Census and Statistics Office) because of the elimination of population classified as urban but engaged in agriculture. See The Philippines; Priorities and Prospects for Development (Washington, D.C.: The World Bank, 1976), Table 5.1, p. 93.

Table II-6
Distribution of Population with College Degrees by Major Field of Study, Philippines, Urban and Rural, 1970

Field of Study	Philippines Number	Philippines Per Cent	Urban Number	Urban Per Cent	Rural Number	Rural Per Cent
All Fields	1,083,760	100.0	779,880	100.0	303,880	100.0
Natural Science[1]	12,620	1.2	10,485	1.3	2,135	0.7
M.S. and Ph.D.	388		333		55	
Bachelor's Degree	12,232		10,152		2,080	
Engineering[2]	86,260	8.0	68,342	8.8	17,918	5.9
M.S. and Ph.D.	831		659		172	
Bachelor's Degree	70,061		56,587		13,474	
Associate in Mechanical Engineering	15,368		11,096		4,272	
Medical Science[3]	88,240	8.1	72,711	9.3	15,529	5.1
M.S. and Ph.D.	2,128		1,766		362	
Doctor of Medicine	20,949		18,013		2,936	
Doctor of Optometry	1,997		1,734		263	
Doctor of Dental Med.	11,181		9,371		1,810	
Bachelor's Degree	42,691		35,697		6,994	
Certificate of Midwifery	9,294		6,130		3,164	
Agriculture[4]	17,363	1.6	10,444	1.3	6,919	2.3
M.S. and Ph.D.	650		480		170	
Bachelor's Degree	15,372		9,163		6,209	
Associate in Agriculture, etc.	1,341		801		540	
Humanities and Fine Arts	52,066	4.8	42,011	5.4	10,055	3.3
Education	478,232	44.1	293,990	37.7	184,242	60.6
Law	43,795	4.0	37,072	4.8	6,723	2.2
Social Science	255,009	23.5	215,331	27.6	39,678	13.1
Course not stated	50,175	4.6	29,474	3.8	20,681	6.8

Source: Republic of the Philippines, National Census and Statistics Office, _Philippines, 1970 Census of Population and Housing_, _National Summary_, Vol. II (Manila: 1972), Table III-10, pp. 362-370.

Details may not add up to totals due to rounding.

[1] Includes physics, chemistry, pharmaceutical chemistry, mathematics, botany, geology, zoology, biological science, nutrition, etc.

[2] Includes chemical, civil, electrical, mechanical and management engineering, airline operation engineering, naval architecture and marine engineering, etc.

[3] Includes pharmacy, nursing, medical technology and midwifery.

[4] Includes agriculture and forestry.

medical sciences, M.D.s or physicians were mostly found in the urban areas, i.e. 18,013 or 86 per cent of the country's total supply.

As is evident from Table II-6, relatively few individuals specializing in engineering or science possessed advanced degrees, i.e. Master of Science or Ph.D. degrees. In fact, the largest number of advanced degree holders was in the medical sciences. Most of these persons (1,766 or 83 per cent) were also found in the urban areas. Similarly, the majority of those with advanced degrees in the natural sciences (333 or 85.8 per cent), engineering (659 or 79.3 per cent) and agriculture (480 or 73.8 per cent) were found in the urban areas.

As can be seen from Table II-7, Manila and Rizal had over half (51.7 per cent) of the natural scientists in the Philippines, 46.3 per cent of the country's supply of engineers and 42.2 per cent of the medical scientists. As could be expected, the proportion of agricultural scientists in Manila was relatively small, 4.4 per cent, as well as in Rizal province which had only 13.5 per cent.

The Table also shows that in 1970, 2,980 or 14.2 per cent of the country's 20,949 M.D.s were found in Manila and 6,305 or 30.1 per cent in the province of Rizal. This pattern of distribution was also shown by a separate survey of medical manpower undertaken by the Association of Philippine Medical Colleges (APMC) in that year. The APMC study found that 65 per cent of the country's 14,100 practicing physicians were in Greater Manila (which included parts of Rizal province), and in cities and provincial capitals other than Greater Manila. Greater Manila alone had 5,358 (38 per cent) of the total number of practicing physicians. Other cities and provincial capitals had 3,807 (27 per cent) and the rest of the country had only 4,935 (35 per cent) of the

Table II-7
Distribution of Population with College Degrees
By Major Field of Study, Philippines,
Manila and Rizal, 1970

Field of Study	Philippines		City of Manila		Rizal Province	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
All Fields	1,083,760	100.0	118,964	100.0	243,651	100.0
Natural Science[1]	12,620	1.2	2,014	1.7	4,507	1.8
M.S. and Ph.D.	388		45		160	
Bachelor's Degree	12,232		1,969		4,347	
Engineering[2]	86,260	8.0	12,923	10.9	26,976	11.1
M.S. and Ph.D.	831		81		380	
Bachelor's Degree	70,061		11,010		23,177	
Associate in Mechanical Engineering	15,368		1,832		3,419	
Medical Science[3]	88,240	8.1	12,763	10.7	24,873	10.2
M.S. and Ph.D.	2,128		237		659	
Doctor of Medicine	20,949		2,980		6,305	
Doctor of Optometry	1,997		369		529	
Doctor of Dental Med.	11,181		1,654		3,129	
Bachelor's Degree	42,691		6,704		12,387	
Certificate of Midwifery	9,294		819		1,864	
Agriculture[4]	17,363	1.6	763	0.6	2,341	1.0
M.S. and Ph.D.	650		18		88	
Bachelor's Degree	15,372		692		2,094	
Associate Degree	1,341		53		159	
Humanities and Fine Arts	52,066	4.8	7,026	5.9	15,766	6.5
Education	478,232	44.1	28,102	23.6	56,629	23.2
Law	43,795	4.0	6,701	5.6	14,439	5.9
Social Science	255,009	23.5	44,917	37.6	88,225	36.2
Course not stated	50,175	4.6	3,755	3.2	9,895	4.1

Source: Republic of the Philippines, National Census and Statistics Office, Philippines, 1970 Census of Population and Housing, National Summary, Vol. II, Table III-11, pp. 371-442.

Details may not add up to totals due to rounding.

[1] Includes physics, chemistry, pharmaceutical chemistry, mathematics, botany, geology, zoology, biological science, nutrition, etc.

[2] Includes chemical, civil, electrical, mechanical and management engineering, airline operation engineering, naval architecture and marine engineering, etc.

[3] Includes pharmacy, nursing, medical technology and midwifery.

[4] Includes agriculture and forestry.

practicing physicians.[16]

Available employment statistics published more recently do not provide specific data on the regional distribution of scientists and engineers but this can generally be inferred from the number of employed persons by major occupation group. As shown earlier, the population with four or more years of college education, to which the scientists and engineers generally belong, are mostly found among the categories of professional, technical and related workers, and administrative, executive and managerial workers. In 1975, the professional, technical and related workers in the country made up 805,000 or 5.5 per cent of the total number of employed persons (14,517,000). Administrative, executive and managerial workers comprised 148,000 or 1.0 per cent of the total number of employed persons.

Over two-thirds (67.1 per cent or 540,000) of the country's employed professional, technical and related workers in 1975 were in the urban areas. This was also true for the category of workers employed as administrative, executive and managerial workers, of which 120,000 or 81.1 per cent were in the urban areas. Of those employed in the urban areas, the Metropolitan Manila Area had less than a third (28.6 per cent or 154,614) of the professional, technical and related workers or nearly a fifth (19.2 per cent) of the country's total. Nearly half (45.3 per cent or 54,398) of the administrative, executive and managerial workers in the urban areas were also found in the Metropolitan Manila Area. This represented about 36.8 per cent of the Philippine total of

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[16]Jose Cuyegkeng, M.D., "The (External) Migration of Philippine Medical Graduates -- Its Magnitude, Causes and Solutions," paper presented in the International Macy Conference on Development, Migration and Medical Manpower, Bellagio, Italy, on 4-10 October, 1970, (mimeo.), Table IV, p. 7.

this category of workers.[17]

While the overall picture in the country is one of some underemployment or unemployment of qualified professionals, there are regions where some professions are in short supply. A random survey, for example, of some regions in 1972 revealed that there were shortages of doctors, nurses, engineers, and fisheries experts in Legaspi City and the Bicol Region, Cebu City and its region, as well as Davao City and its surrounding region.[18] Shortages of other qualified professionals, technicians and skilled workers were found in these regions and in other parts of the country. There have also been news reports as recently as 1976 of provincial hospitals and municipal health units lacking physicians and nurses.[19]

Brain Drain of Scientists and Engineers

As mentioned at the beginning of this chapter, the underemployment and unemployment in the Philippines of scientists, engineers, physicians and surgeons has been widely regarded as one major reason for their immigration to other countries, especially to the United States and Canada. The enactment by the United States Congress of the Immigration and Nationality Act of 1965 has been a contributing factor. The new Act abolished the national origins quota system, which had been in effect

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[17] Republic of the Philippines, National Census and Statistics Office, "Labor Force: August 1975," Tables No. 34-35, pp. 32-35; and 1975 Integrated Census of the Population and Its Economic Activities: Population, Metropolitan Manila (Manila: November 1975), pp. xxv.

[18] M. L. Gupta, "The Philippine Regional Manpower, Employment and Income Situation," Manpower Philippines, Vol. I, No. 1 (September 1973), pp. 62-70.

[19] See, for example, "Brain Drain Holds Back Rural Health," Times Journal, 31 January 1976, p.5; "Gov't Doctors Resign; Health Crisis hits Zambo," Bulletin Today, 22 June 1976, p. 31.

since 1929, replacing preference for Europeans by a preference for persons with skills, regardless of nationality, which were considered by the Secretary of Labor to be "especially advantageous to the United States."[20] The effect of the new Act, which was fully implemented by July 1968, was a large increase in the number of professional, technical and kindred workers from the Philippines immigrating to the United States. This can be seen from Table II-8.

As shown, the number of engineers and natural scientists entering the United States as immigrants from 1962 to 1966 was quite small, 86 and 81 respectively. In 1967, however, when the new Immigration and Nationality Act became partly effective, the number of engineers admitted as immigrants increased to 348, a jump of 305 per cent over the preceding five-year period. The number of natural scientists admitted increased to 106, a jump of 30.1 per cent over that of the preceding five years. In 1968, immigrant Filipino engineers to the United States reached 746, which was more than twice their number in 1967 or an increase of 114 per cent. The number of immigrant natural scientists in 1968 reached 187, an increase of 76 per cent over 1967. The number of immigrant physicians, surgeons and dentists also increased steadily, though less dramatically compared with engineers. In the decade 1962 to 1972, 5,672 engineers, 1,726 natural scientists, 211 social scientists and 5,826 physicians, surgeons and dentists left the

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[20]Judith Fortney, "Immigrant Professionals, A Brief Historical Survey," International Migration Review, Vol. VI, No. 1 (Spring 1972), p. 55; Sheldon Friedman, "The Effect of the US Immigration Act of 1965 on the Flow of Skilled Migrants from Less Developed Countries," World Development, Vol. I, No. 8 (August 1973), pp. 39-44; Monica Boyd, "The Changing Nature of Central and Southeast Asian Immigration to the United States: 1961-1972," International Migration Review, Vol. VIII, No. 1 (Spring 1974), pp. 507-519.

Table II-8
Immigration of Scientists, Engineers, Physicians and Surgeons to the United States of America from the Philippines, Fiscal Years 1962-1972

Occupation	Fiscal Year							
	1962-66	1967	1968	1969	1970	1971	1972	Total
Engineers	86	348	746	1,068	1,163	1,096	1,165	5,672
Natural Scientists	81	106	187	333	283	396	340	1,726
Social Scientists	21	15	13	24	67	36	35	211
Physicians and Surgeons[a]	608	550	846	983	968	1,040	831	5,826
Professional Nurses	358	435	891	796	957	--	--	3,437
Total	1,154	1,454	2,683	3,204	3,438	2,568	2,371	16,872
All Professional, Technical and Kindred Workers (PTKW) from the Philippines	2,621	2,800	4,844	7,130	8,811			
Total PTKW from Asia			13,036	16,683	22,568	13,803[b]	13,713[b]	
Total PTKW from LDCs	57,595	23,705						
Total PTKW from the World	139,225	41,652	48,753	40,427	46,151	18,850[b]	18,466[b]	
PTKW from the Philippines as % of Asia or of LDC Total	4.6	11.8	37.2	42.7	39.0	18.6[b]	17.3[b]	
PTKW from Philippines as % of World Total	1.9	6.7	9.9	17.6	19.1	13.6[b]	12.8[b]	

Sources of data: For fiscal years 1962-66 and 1967, statistics compiled by Gregory Henderson, Emigration of Highly Skilled Manpower from the Developing Countries (New York: United Nations Institute for Training and Research, 1970),pp. 170, 172; for fiscal years 1968-1970, M.L. Gupta, "Outflow of High-Level Manpower from the Philippines, with Special Reference to the Period 1965-1971," International Labour Review, Vol. 107, No. 2 (February 1973), Table III, p. 172; for fiscal years 1971-72, U.S., Library of Congress, Congressional Research Service, Foreign Affairs Division, Brain Drain: A Study of the Persistent Issue of International Scientific Mobility; Science,Technology and American Diplomacy, Prepared for the Sub-Committee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs, U.S. House of Representatives (Washington, D.C.: Government Printing Office, 1974), Table 13, p. 69.

[a]Includes physicians, surgeons and dentists.

[b]Includes only scientists, engineers, physicians and surgeons.

Philippines to reside in the United States. As can also be seen from Table II-8, the Philippine contribution to professional, technical and kindred workers in the United States has risen considerably from 1968 in relation to the total numbers coming from Asia as well as the rest of the world. In 1971 and 1972, the Philippine share of scientists, engineers, physicians and surgeons immigrating to the United States from the whole of Asia was 18.6 and 17.3 per cent,respectively, and as a share of the world total, 13.6 per cent and 12.8 per cent,respectively.

Highly-trained manpower in the Philippines has also been lost to Canada. From 1965 to 1971, 9,867 professionals from the Philippines were shown as admitted as immigrants to Canada. This group includes physicians, nurses, engineers, etc. It is very likely, however, that the actual numbers of highly-trained people immigrating to Canada was larger than this because engineers, doctors, and others admitted to Canada are not allowed to practice their professions until after they have obtained Canadian professional qualifications. Many of these are, therefore, initially admitted as immigrants under another category. Table II-9 shows the distribution of Filipino immigrants to Canada according to their intended occupation for the period 1965 to 1971.

Available immigration statistics show that in 1968, 78 Filipino physicians and surgeons were among the professionals admitted as immigrants into Canada. They made up 6.1 per cent of the 1,277 physicians and surgeons coming from all countries who entered Canada as immigrants. In that same year, Canadian medical schools produced 1,002 physicians and surgeons. Filipino physicians and surgeons admitted as immigrants was thus 7.8 per cent of the number of Canadian graduates.[21]

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[21]Allan G. Green, Immigration and the Post War Canadian Economy (Toronto: The MacMillan Co. of Canada, 1976), p. 266.

Table II-9
Immigration to Canada from the Philippines
by Intended Occupation Group, 1965-1971

Intended Occupation	Year 1965	1966	1967	1968	1969	1970	1971
Managerial	8	6	11	19	16	43	93
Professional	1,150	1,950	2,022	1,537	1,336	1,152	690
Clerical	87	216	190	414	492	811	1,176
Transportation	2	2	1	2	3	13	14
Communication	1	0	2	1	1	3	7
Commercial	4	4	6	9	24	46	61
Financial	0	1	2	8	10	10	12
Service	17	74	345	166	100	104	176
Agricultural	3	1	5	5	5	9	18
Construction	6	5	7	6	18	25	31
Fishing, Trapping and Logging	0	0	0	2	2	1	0
Mining	0	0	0	2	1	2	2
Manufacturing & Mechanical	6	16	38	107	491	184	442
Laborers	1	0	2	10	13	10	20
Other	0	0	1	0	8	16	40
Non-workers	217	364	362	390	481	811	1,398
Total	1,502	2,639	2,994	2,678	3,001	3,240	4,180
Asian Total	11,684	14,327	21,228	21,686	23,319	21,170	22,171
World Total	146,758	194,743	222,876	183,974	161,531	147,713	121,900
Philippine Total as Percentage of Asian Total	12.9	18.4	14.1	12.3	12.9	15.3	18.9
Philippine Total as Percentage of World Total	1.0	1.4	1.3	1.5	1.9	2.2	3.4

Source: Department of Citizenship and Immigration/Department of Manpower and Immigration, Immigration Statistics Canada, 1965 to 1971, in Gupta, "Outflow of High-Level Manpower from the Philippines, with Special Reference to the Period 1965-1971," p. 173.

The Association of Philippine Medical Colleges (APMC), in its physician manpower survey in 1969, estimated that there were 500 Filipino physicians and surgeons who had immigrated to Canada. Immigrant Filipino physicians to other countries were estimated to have reached 250 as of 1969. The APMC survey gave the total number of Filipino physicians out of the Philippines as of 31 December 1969 as 9,320. Of this number, 61.4 per cent (5,720) were estimated to be permanently out, and 38.6 per cent (3,600) were temporarily away on the exchange visitors' program with the United States (3,500) or under contract to other governments (100).[22] It is very likely that many of those who were considered temporarily out in 1969 have already joined the ranks of the permanent immigrants as the immigration statistics indicate that many of those issued permanent immigrant visas each year were already in the United States as holders of visitor's visas.

How significant is the brain drain of scientists and engineers from the Philippines? Expressed as a proportion of the total stock of registered professionals in the Philippines as at 31 December 1969, the total outflow in 1970 to all countries of immigration constituted 2.8 per cent of physicians and surgeons, 1.7 per cent of dentists, 3.8 per cent of all engineers, 22.5 per cent of dieticians and nutritionists and 3.6 per cent of veterinarians.[23] Viewed from this perspective, the brain drain does not seem to be very large. It should be pointed out, however, that the registry of various professions in the country is cumulative since the time that boards of examiners were set up for

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[22] Cuyegkeng, _op. cit._, Table III, p. 6.

[23] Gupta, "Outflow of High-Level Manpower from the Philippines," p. 178.

each profession. Hence, they do not take into account registered professionals who have since died or retired from active practice. The brain drain should, therefore, be viewed against the increment to the total stock of professionals for a given year. Table II-10 gives the increment in the stock of selected professions in the Philippines in 1968-69 and the outflow from the stock in 1970.

For all fields of engineering, the total outflow from the Philippines, i.e. number of those leaving the country as immigrants to the United States and other countries in 1970 constituted 61.0 per cent of the newly registered professionals in 1968-69. The outflow of physicians and surgeons was 61.3 per cent of the addition to the profession in 1968-69, and of dentists, 92.1 per cent of the increment to the stock in 1969.

If these and other statistics that can be read from the table are accepted as reflecting accurately the magnitudes of addition to the professions and the outflow from the stock for a given year, then the brain drain constitutes a large proportion of the highly-qualified manpower in the Philippines. The registered professionals represent the cream of the graduating class as evidenced by their success in passing the professional board examinations. Since there are no professional board examinations for such scientific fields as physics, botany, biology, zoology, and others,the loss of these highly-trained people cannot similarly be measured. But, for example, a physicist estimated in 1970 that of some 30 Filipinos who would be finishing their Ph.Ds. in physics in various schools in the United States by 1974, 20 would probably end up as permanent losses to the country.[24]

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[24] Amador Muriel, "Brain Drain in the Philippines: A Case Study," Bulletin of the Atomic Scientists,Vol.XXVI, No.7 (September 1970),p. 38.

Table II-10
Increment in the Stock of Selected Professions
in 1969 and Outflow from Stock in 1970

	Increment in stock as of FY 1968-69	Outflows from stock in 1970: To USA	To Canada	Other	Total	Outflow as Percentage of Increment
Engineers:						
Aeronautical	*	8	--	--	8	*
Architectural	122	130	3	2	135	111.0
Chemical	500	273	3	--	276	55.0
Civil (including Sanitary)	345	214	10	12	236	68.4
Electrical	208[a]	127	4	2	133	63.9
Industrial	*	32	3	--	35	*
Mechanical (including Textile)	678[b]	314	4	21	339	50.0
Mining (including Metallurgical	32	18	4	--	22	68.8
Other (including Sales)	348[c]	177	1	--	178	51.1
Total	2,233	1,293	32	37	1,362	61.0
Health and Medical Personnel:						
Physicians and Surgeons	1,344	770	52	2	824	61.3
Dentists	216	198	1	--	199	92.1
Nurses	2,585	954	518	--	1,472	56.9
Optometrists	74	55	--	--	55	74.3
Medical and Dental Technologists	*	115	202	--	317	*
Midwives	378	--	--	80	80	21.2
Pharmacists	329	262	4	--	266	80.9
Dieticians and Nutritionists	107	183	11	--	194	181.3
Veterinarians	38[d]	23	3	--	26	68.4[d]
Total	5,071	2,560	791	82	3,433	67.7

Sources of data: For increment in stock as of FY 1968-69, The Journal of Philippine Statistics, Vol.20, No.4 (4th Quarter 1969), Table 3.10, p. 31; for outflows, Gupta,"Outflow of High-level Manpower from the Philippines with Special Reference to the Period 1965-71," Table IX, p. 178.

*Not covered by professional board examinations, hence, no existing registry of members of the profession.

[a] Includes grades of professional, associate, and assistant electrical engineers.

[b] Includes professional mechanical engineer, mechanical plant engineer and junior mechanical engineer.

[c] Includes 315 geodetic engineers, 11 naval architects and marine engineers and 22 professional agricultural engineers added to the stock in 1968-69.

[d] Number of graduates only, not additions to professional registry.

The brain drain, or permanent loss of scientists, engineers and physicians from the Philippines, must also be seen in terms of educational cost to the country. A study prepared for the Subcommittee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs in the U.S. House of Representatives in 1974 estimated that the 1,528 Filipino engineers and scientists entering the United States as immigrants in fiscal year 1971 cost the Philippines $30,560,000 in educational expenses. The 1,040 physicians and surgeons entering the United States in the same year were estimated to have cost $20,800,000. Estimates of the educational cost to the Philippines of the 1,540 Filipino engineers and scientists and 831 physicians and surgeons entering the United States as immigrants in fiscal year 1972 were $30,800,000 and $16,620,000, respectively. Thus, in fiscal years 1971 and 1972 alone, the immigrant Filipino scientists, engineers, physicians and surgeons to the United States cost the Philippines some $98.8 million.[25] This estimate was based on the figure of $20,000 as the cost of educating each professional in 1967.

Estimates of the brain drain from the Philippines to the United States, in terms of educational savings to the latter were even higher. Filipino scientists, engineers, physicians and surgeons emigrating to the United States in fiscal years 1971 and 1972 were estimated to have saved the United States $266.6 million in education costs. The study showed that these savings to the United States were 51.2 per cent <u>more</u>

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[25] U.S., Library of Congress, Congressional Research Service, <u>Brain Drain: A Study of the Persistent Issue of International Scientific Mobility</u>; prepared for the Subcommittee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs, U.S. House of Representatives (Washington, D.C.: Government Printing Office, 1974), Tables 23 and 24, pp. 155-156.

than the cost of United States economic aid to the Philippines for the same period ($136.5 million).[26] This supports the contention that the brain drain actually constitutes "reverse foreign aid"[27] or "reverse transfer of technology"[28] from the less developed countries to the more developed countries.

The foregoing discussion of the costs of the brain drain helps to explain the continuing interest in the problem of the emigration of high-level manpower from less developed to more developed countries and in finding out the causes of the problem and considering policies that can be adopted to stop or reverse this trend.[29] Considerable attention has been focused, for example, on how to tax the brain drain and channel the revenue thus generated for the development of the losing countries.[30]

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[26] Ibid., Tables 27-28, 36, pp. 170-171, 250.

[27] J. Douglas Muir, "Letter to the Editor: The Reduction of the Brain Drain: Problems and Policies," Minerva, Vol.VII, No. 3 (Spring 1969), pp. 394-398.

[28] United Nations Conference on Trade and Development, "The Reverse Transfer of Technology: Economic Effects of the Outflow of Trained Personnel from Developing Countries (Brain Drain)," Trade and Development Board: Intergovernmental Group on the Transfer of Technology; Third Session, Geneva, 15 to 26 July 1974 (TD/B/AC/.11/25).

[29] See, for example, Herbert G. Grubel, "The Reduction of the Brain Drain: Problems and Policies," Minerva, Vol. VI, No. 4 (Summer 1968), pp. 541-558; and his "Reflections on the Present State of the Brain Drain and a Suggested Remedy," Minerva, Vol.XIV, No.2 (Summer 1976),pp. 209-224; Herbert G. Grubel and Anthony Scott, The Brain Drain: Determinants, Measurement and Welfare Effects (Waterloo, Ontario: Wilfrid Laurier University Press, 1977); Jagdish Bhagwati, "The Brain Drain," International Social Science Journal, Vol.XXVIII, No.4 (1976), pp. 691-729; Ernesto M. Pernia, "The Question of the Brain Drain from the Philippines," International Migration Review, Vol.X, No.1 (Spring 1976), pp. 63-72; William Glaser and G.Christopher Habers, The Brain Drain: Emigration; UNITAR Research Report No. 22 (Oxford/New York: Pergamon Press, 1978).

[30] Jagdish Bhagwati and William Dellalfar, "The Brain Drain and Income Taxation," World Development, Vol.I, Nos.1 & 2 (February 1973),pp. 94-101; Jagdish Bhagwati and Martin Partington,eds., Taxing the Brain Drain: I. A Proposal (Amsterdam:North Holland Publishing Co.,1976); Jagdish Bhagwati, ed.,The Brain Drain and Taxation: II. Theory and Empirical Analysis (Amsterdam: North Holland Publishing Co., 1976).

There have, of course, been other views about the brain drain. One writer looks at it not so much as a loss but more of an "overflow" of a developing country's excess manpower resources as the number of professional graduates has been increasing faster than its economy can absorb.[31] The brain drain could thus be regarded as a "social safety valve" as it helps to alleviate the unemployment problems of its educated manpower.[32] Moreover, it has been pointed out that the brain drain is also an important source of foreign exchange insofar as the emigrants remit part of their earnings to their relatives in the home country.[33] It has also been argued that the scientist from a developing country may be able to maximize his contribution to the advancement of scientific knowledge while working with the facilities available in a developed economy. This potential contribution may not be possible if the scientist remains in his home country. Such scientific knowledge can benefit developed as well as less developed countries.[34] This argument, of course, assumes that this knowledge is then utilized in the donor country. But this raises the question whether the donor country is equipped to do so.

Differing interpretations about the significance of the emigration

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[31] George B. Baldwin, "Brain Drain or Overflow," Foreign Affairs, Vol. 48, No. 2 (January 1970), pp. 358-372.

[32] Deena R. Khatkhate, "The Brain Drain as a Social Safety Valve," Finance and Development, Vol. 7, No. 1 (March 1970), pp. 34-39.

[33] Gregory Henderson, Emigration of Highly Skilled Manpower from Developing Countries; UNITAR, Research Report No. 3 (New York: United Nations Institute for Training and Research, 1970), pp. 125-127.

[34] See, for example, Harry G. Johnson, "Economics of the 'Brain Drain': The Canadian Case," Minerva, Vol. III, No. 3 (Spring 1965), pp. 299-311; Herbert G. Grubel and Anthony D. Scott, "The International Flow of Human Capital," American Economic Review; Papers and Proceedings, Vol. LVI, No. 2 (May 1966), pp. 268-274.

of high-level manpower, i.e. whether it constitutes a loss or an advantage for the country of outflow, stems from differences in emphasis in the analysis of the problem -- national versus international welfare and social needs in a developing country as against economic demand for manpower. Analysis of the problem is made more difficult by the lack of reliable statistics on international migration. This is central to the problem of identifying the magnitude of permanent loss of manpower as against temporary movement of scientists and engineers. Immigration statistics fail to show the qualitative assessment of the loss or gain in the brain drain in terms of differences in level of education and training involved, as well as to account for return flows of high-level manpower to the country of origin. There is also a lack of information on the domestic stock of professional manpower among the countries of outflow, their level of training, rural and urban distribution as well as projected demands for these individuals, against which their brain drain could be more realistically assessed.

In the case of the Philippines, the discussion has shown that there were undoubtedly some surpluses in the country's supply of high-trained manpower, particularly in engineering and the health sciences, in the recent past. This could be inferred from the data presented on the underemployment and unemployment of scientists, engineers and physicians. It was also shown that there is a maldistribution of these people in the country, with most of them being concentrated in the urban areas. The underemployed and unemployed professionals in the urban areas have thus been led to seek "greener pastures" in other countries while many of the rural areas have been deprived of the needed professional manpower. This has undoubtedly contributed to the underdeveloped state of the rural areas as well as the nation in general. The maldistribution of professional manpower can thus be viewed as one of the causes of their underemployment and unemployment as well as their emigration to other countries. It is commonly accepted that a further cause of the brain drain in the Philippines has been the practice of making appointments and promotions, in government particularly, on the basis of partisan political considerations and connections. This deprives professionals, especially scientists, engineers and physicians, of their proper recognition and incentives for advancement.[35] In some cases, this has resulted in the loss of key individuals who are needed in the development process. If the brain drain should continue to take away these individuals from the Philippines, it would certainly have adverse effects on its development process. As one writer has expressed it:

> Gifted, educated, experienced leaders are scarce almost everywhere, including the United States. These are the brains that really count, because they have such high leverage. They are not to be defined in terms of genius or Nobel-laureate quality; but their number is only a small fraction (5-10 per cent) of all professional migrants. They are the outstanding individuals who are unlikely to be satisfactorily replaced even if a country has dozens of men with the same educational qualifications waiting to apply for their posts if they leave.[36]

<u>Summary</u>

This chapter has examined the problems of underemployment and unemployment of scientists, engineers and physicians, not only in terms of

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[35] Gupta, op.cit., p. 181; "Solving the Brain Drain,"Editorial, *Philippines Daily Express*, 24 June 1977, p.4. No less than the Secretary of Foreign Affairs, Carlos P. Romulo, stated that the brain drain, especially in the early 1970's, "was not just the result of lack of economic opportunity; it was also caused by despair over corruption and lawlessness, a lack of faith in the future of the country." See his Foreword to Ferdinand E. Marcos, *The Democratic Revolution in the Philippines*, Second Edition (Manila: 1977), p. 16.

[36] Baldwin, op. cit., p. 363.

their having no work or having only part-time work, but also in the sense of the underutilization of their educational training and preparation because of the lack of suitable jobs. This problem has arisen from the overproduction of graduates in certain fields of study as well as the maldistribution of professionals in the different regions of the country, especially between urban and rural areas. The underemployment and unemployment of scientists, engineers and physicians has been widely regarded as a major cause of their immigration to the United States of America, Canada and other countries. This chapter has, therefore, also looked into the magnitude of the brain drain, in terms of numbers lost and fields of study, educational costs to the Philippines, and the possible loss of key individuals whose talents and training are needed for many of the country's development programs. It was pointed out that the examination of the problem of unemployment, underemployment and brain drain of professionals was hampered by the lack of precise and up-to-date statistics on the Philippine manpower situation as well as on the degree of permanency of loss of professional scientists, engineers and physicians. The existing studies on the problem have, therefore, been pieced together bearing in mind these limitations.

The problems outlined thus far must next be looked at as part of the background of government policies (or the absence of them) in respect to scientific education, training and research. The succeeding chapters will, therefore, examine the government's science policy, particularly, in respect to the education and training of scientists, engineers, physicians and surgeons. The major question asked in this study is: What has the government of the Philippines done since independence in 1946 to encourage scientific education, training and research in fields considered essential to its socioeconomic development goals and programs? In an attempt to answer this question, the next chapter will investigate the structure of science education and training in the Philippines. Chapter IV will examine the professional organization of scientists and engineers and the role they play in the education and training of their members as well as in policy-making for education and scientific research. Chapter V will look into the employment of scientists and engineers in the Philippines. The structure and processes of science policy formulation and implementation are discussed in Chapter VI.

The study looks at government policies for scientific education and training as constituting both independent as well as dependent variables. As the independent variable, government science policies affect the supply of scientists and engineers, and hence their employment/under-employment and ultimately the problem of the brain drain. It must be recognized, however, that government policies are themselves the outcome of inputs of competing demands for the regulation of the use or the allocation of scarce resources and inputs of support from different groups or sectors of a society. In this sense, government science policies are also dependent variables.

Chapter III

Structure of Science Education and Training

Much of the present structure of science education and training in the Philippines took shape during the American regime from 1898 to 1946. Under the Spanish colonial administration, which lasted for almost four hundred years, education was geared mainly towards the propagation of the Catholic faith. Various decrees were issued in Spain calling for the establishment of a school system in the colony but these were not effectively carried out.[1]

Primary instruction during the Spanish regime was generally taken care of by the missionaries and parish priests in the villages and towns. Owing to the dearth of qualified teachers, textbooks and other instructional materials, this was mainly religious education and characterized by rote learning. Higher education was provided by schools set up by the different religious orders in the urban centers, most of them in Manila. For example, the Jesuits founded in Cebu City the Colegio de San Ildefonso (1595) and in Manila, the Colegio de San Ignacio (1595), the Colegio de San Jose (1601) and the Ateneo de Manila (1859). The Dominicans had the Colegio de San Juan de Letran (1640) in

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[1]Henry Frederick Fox, "Primary Education in the Philippines, 1565-1863," Philippine Studies, Vol. 13 (1965), pp. 207-231; Encarnacion Alzona, A History of Education in the Philippines, 1565-1930, First Edition (Manila: University of the Philippines Press, 1932), pp. 20-23, 46-52; Eliodoro G. Robles, The Philippines in the Nineteenth Century (Quezon City: Malaya Books Inc., 1969), pp. 219-229.

Manila.[2] Access to these schools was, however, limited to the elite of the colonial society -- the European-born and local Spaniards, the mestizos and a few native Filipinos. Courses leading to the B.A. degree, Bachiller en Artes, were given which by the nineteenth century included science subjects such as physics, chemistry, natural history and mathematics.[3] On the whole, however, higher education was pursued for the priesthood or for clerical positions in the colonial administration. It was only during the latter part of the nineteenth century that technical/vocational schools were established by the Spaniards.[4]

University Education During the Spanish Regime

When the Americans took over the colonial administration of the Philippines, there was only one existing university, the royal and pontifical University of Santo Tomas.[5] Run by the Dominicans, it was

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[2]The Colegio de San Ildefonso grew to become the present University of San Carlos in Cebu City. It was taken over by the Society of the Divine Word in 1933 and continues to be administered by this Order. The Colegio de San Ignacio prospered and was elevated to the rank of a royal and pontifical university in 1621. It was closed when the Jesuits were expelled from the Philippines on 17 May 1768 by a royal decree of Charles III. The Ateneo de Manila is now a University run by the Jesuits. The Colegio de San Juan de Letran remains an exclusive boys' school. Alzona, op. cit., pp. 24-29; W. Cameron Forbes, The Philippine Islands, Vol. I (Boston and New York: Houghton Mifflin Co., 1928), pp. 412-415.

[3]The B.A. then was more equivalent to the present high school diploma.

[4]The first school of arts and trades was founded in the province of Pampanga and a school of agriculture was opened in Manila in 1889. See Alzona, op. cit., pp. 43-46, 158-164.

[5]There was a Royal University of San Felipe established in Manila by a royal decree of 1707. It remained open until 1726 when its work was taken over by the Jesuit University of San Ignacio which was closed in 1768. See ibid., p. 31.

established as the College of Santo Tomas in 1611 by Fray Miguel de Benavides of the Order of Preachers. It initially granted degrees in theology, philosophy and the humanities.[6] During the eighteenth century, the faculty of jurisprudence and canonical law was established. In 1871, the schools of medicine and pharmacy were opened. From 1871 to 1886, the University of Santo Tomas granted the degree of Licenciado en Medicina to 62 graduates.[7] For the doctorate degree in medicine, at least an additional year of study was required at the Universidad Central de Madrid in Spain.

The study of pharmacy consisted of a preparatory course with subjects in natural history and general chemistry and five years of studies in subjects such as pharmacology, chemical and organic chemistry and practical work in pharmaceutical operations at the school of pharmacy. At the end of this period the degree of Bachiller en Farmacia was granted. The degree of licentiate in pharmacy, which was equivalent to a master's degree, was granted after two years of practice in a pharmacy, one of which could be taken simultaneously with the academic courses after the second year course of study. In 1876, the university granted the bachelor's degree in pharmacy to its first six graduates in the school of pharmacy. Among them was Leon Ma. Guerrero, who is usually referred to as the "Father of Philippine Pharmacy" because of his extensive work on the medicinal plants of the Philippines and their

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[6]The following brief history of the University of Santo Tomas is based on an account written by Fray E. Arias reproduced in United States, Bureau of the Census, Census of the Philippine Islands, 1903, Vol. III (Washington, D.C.: Government Printing Office, 1905), pp. 621-631.

[7]Ibid., p. 631.

uses.[8] The total number of graduates in pharmacy during the Spanish period was 164.[9]

There were no schools offering engineering at that time. The few who studied engineering had to go to Europe. There was a Nautical School created on 1 January 1820 which offered a four-year course of study that included such subjects in arithmetic, algebra, geometry, trigonometry, physics, hydrography, meteorology, navigation and pilotage. Other professional schools that existed during the nineteenth century were the School of Commercial Accounting and the School of French and English Languages which was established in 1839.[10]

In 1863, the colonial authorities issued a royal decree designed to reform the existing educational system in the country. It provided for the establishment of a system of elementary, secondary and collegiate schools, teacher-training schools, and called for government supervision of these schools. The full implementation of this decree, however, was interrupted by the coming of the Americans in 1898.

Higher education during the Spanish regime was generally viewed with suspicion and feared by the colonial authorities as encouraging

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[8] His works included Medicinal Plants of the Philippine Islands, published in 1903 and Medicinal Uses of Philippine Plants, published in 1921. See Miguel Ma. Varela, S.J. et al, Scientists in the Philippines (Bicutan, Taguig, Rizal: National Science Development Board, 1974), pp. 95-114.

[9] Milagrosa G. Niño, "Pharmaceutical Education in the Philippines," Unitas; revista de cultura y vida universitaria, Vol. 43 (June 1970), p. 73.

[10] Census of the Philippine Islands, 1903, op. cit., pp. 613-615.

conspiracy and rebellion among the native Filipinos. For this reason, only the more daring and persevering students were able to undertake advanced studies. The attitude of the Spanish educators may be seen from the following portion of a report by the Dominican Order in 1887 regarding the University of Santo Tomas which they also called the University of Manila.

> Its organization is simple without being rudimentary. Having for a basis religious education, at the same time that it avoids the danger of professors expounding more or less advanced theories, which in practice sooner or later are reduced to moral ruins, both public and private, it contains the pupil within the circle of a severe discipline, in which, if some apparently see oppression and a suppression of spirit, this apparent oppression is softened by the paternal affection which the priests in charge of instruction know how to bestow among the natives of this archipelago. A constant encouragement to the young, directed by prudent and affectionate discipline, that is the standard observed by the University of Manila as to its pupils.[11]

The attitude of the Spanish friars towards the study of the sciences and medicine was even more discouraging. As one Rector of the University of Santo Tomas in the 1860s said: "Medicine and the natural sciences are materialistic and impious studies."[12] It was not surprising,

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[11]Quoted in <u>ibid.</u>, p. 632.

[12]Quoted in James A. Le Roy, <u>Philippine Life in Town and Country</u> (New York and London: G.P. Putnam's Sons, 1905), p. 206. Sir John Bowring, the British Governor of Hongkong who made an official visit to the Philippines in the 1850s wrote:

> Public instruction is in an unsatisfactory state in the Philippines -- the provisions are little changed from those of the monkish ages.
>
> In the University of Santo Tomas... no attention is given to the natural sciences... nor have any of the educational reforms which have penetrated most of the colleges of Europe and America found their way to the Philippines.

See his <u>A Visit to the Philippine Islands</u> (London: Smith & Elder Co., 1859), p. 194. See also Robert MacMicking, <u>Recollections of Manilla and the Philippines During 1848, 1849 and 1850</u>, ed. and annotated by Morton J. Netzorg (Manila: Filipiniana Book Guild, 1967, reprint of 1851 book published in London by Richard Bentley), pp. 31-32.

therefore, that few Filipinos ventured to study these disciplines. Those who did were poorly trained when compared with those who had gone to European universities. Science courses at the University of Santo Tomas were taught by the lecture/recitation method. Laboratory equipment was limited and only displayed for visitors to see. There was little or no training in scientific research.[13]

In spite of the small number of Filipino graduates from the UST in medicine and the sciences, they still faced the problem of unemployment. This was because the colonial government preferred to appoint Spanish and other European-trained professionals to available positions in the archipelago.[14]

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[13]This can be seen from a description of a physics class at the University of Santo Tomas by Jose Rizal in a chapter of his second novel, El Filibusterismo (The Subversive) written in Europe in 1891. A native of Calamba, Laguna, he studied medicine at UST and continued his scientific training in Spain and Germany. For his two novels and other political writings, he was tried and executed by the colonial authorities in Manila on 30 December 1896.

At the start of the American regime, a German physician of Manila submitted a report to the authorities on the conditions at UST's medical college. The report mentions, among others, its lack of library facilities, the use of outdated textbooks (some published in 1845), that no female cadaver had ever been dissected and the anatomy course was a "farce", that most graduates "never had attended even one case of confinement or seen a case of laparotomy" and that bacteriology had been introduced only since the American occupation and "was still taught without microscopes!" See Le Roy, op. cit., pp. 205-206.

[14]Alzona, op. cit., pp. 143-144, cited a memorial sent to the Madrid exposition in 1887 by officials of the University of Santo Tomas criticizing this government policy and urging its change "in order to prevent political disturbances which might be caused by the large number of dissatisfied professional men who could not find work." See also Census of the Philippine Islands,1903, op. cit., pp. 632-633. Apolinario Mabini wrote: "All the departments and provincial governments were staffed with peninsular Spaniards, personnel unfamiliar with the country and relieved every time there was a cabinet change (in Madrid). Very few Filipinos secured employment as army officers, as officials in the civil administration, or as judges and prosecuting attorneys...." See his The Philippine Revolution translated into English by Leon Ma. Guerrero (Manila: Department of Education, National Historical Commission,1969), p. 27.

Many of these graduates joined the revolutionary movement against Spain. With the opening of the Suez Canal in 1869 and the consequent ease in travel and communications that it brought about, the liberal ideas and scientific knowledge of the West also reached the Philippines. The prosperity that resulted from increased commerce between the Philippines and the rest of the world enabled Filipino students to go to Europe for professional, advanced studies. Jose Rizal, the national hero, for example, was able to pursue further studies in medicine and specialize in opthalmology in Spain and Germany. It was this group of students which set up the Propaganda Movement in Europe that eventually led to the Philippine revolution against Spain in 1896.

Higher Education During the First Republic

During the short-lived Philippine Republic (1898-1900), the government took steps to establish a secular educational system. By a decree of 19 October 1898, it created the Universidad Literaria de Filipinas as a secular, state-supported institution of higher learning. It offered courses in law, medicine, surgery, pharmacy and notary public. During its short life, the University was able to hold graduation exercises in Tarlac on 29 September 1899 when degrees in medicine and law were awarded.[15]

Higher Education During the American Regime

American educational policy in the Philippines was primarily designed to develop literate, civic-minded citizens who could participate

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[15] Most of its faculty and students had actually come from the University of Santo Tomas. See Alzona, *op. cit.*, pp. 177-180; Teodoro A. Agoncillo, *Malolos: The Crisis of the Republic* (Quezon City: University of the Philippines Press, 1960), pp. 250-251.

actively in the democratic processes of government and to provide a pool of Filipino professionals who would eventually take over positions in the colonial bureaucracy as teachers, lawyers, judges, physicians, engineers and scientists.[16]

The Americans introduced a system of secularized public school education as soon as civil government was set up in the islands. On 21 January 1901, the Philippine Commission which acted as the executive and legislative body for the Philippines until 1907, promulgated Act No. 74 creating a Department of Public Instruction in the Philippines. It provided for the establishment of schools that would give free primary education, with English as the medium of instruction. This was followed by the setting up of a Philippine Normal School to train Filipino teachers. Secondary schools were opened after a further enactment of the Philippine Commission in 1902. The Philippine Medical School was established in 1905 and was followed by other professional and technical schools. These were later absorbed into the University of the Philippines.

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[16]As Dr. David P. Barrows, General Superintendent of Education in the Philippines, declared in 1904:

> The encouraging feature of our work is that we are planning and labouring for a people of no mean spirit and no small ambition. The Filipino is quite as eager and ambitious as his successful neighbour, the Japanese, and appears disposed to make no less sacrifices in behalf of his progress. It is in the work of the Bureau of Education that his progress fundamentally and always rests....Material benefits can neither be taken advantage of nor enjoyed by a people illiterate and ignorant. Development of markets and of trade only accompany higher standards of life, and higher standards of life proceed nowhere so quickly as from an advance in education. The successful issue of the public Government inaugurated in this country rests more than anything else on the work done in the schools. If the work done by the Bureau of Education succeeds, the American Government implanted in these islands will succeed. Quoted in Le Roy, *op. cit.*, pp. 231-232.

The University of the Philippines was created on 18 June 1908 by Act of the Philippine Legislature. Among the first colleges to be opened were the College of Agriculture in Los Baños, Laguna in 1909, the Colleges of Liberal Arts, Engineering and Veterinary Medicine in 1910 and the College of Law in 1911. By 1911, the University had an enrollment of 1,400 students.[17] Four years later, its enrollment had almost doubled (to 2,398) and the University included two new units, a School of Pharmacy and a Graduate School of Tropical Medicine and Public Health.[18] In 1916, the School of Forestry and the Conservatory of Music were established; and in 1918, the College of Education was opened.

Except in the College of Medicine, where there were already a number of Filipino physicians who were qualified to become its faculty members when it was opened in 1907, most of the early instructors and professors in the sciences and engineering at the University of the Philippines were Americans and other foreigners. Qualified Filipinos were sent abroad for advanced training and by this means foreign faculty were

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[17] Distributed among its various colleges as follows: College of Liberal Arts -- 215, College of Medicine and Surgery --56, College of Agriculture --186, College of Veterinary Science --14, College of Engineering --11, College of Law --154 and School of Fine Arts --801. See Census Office of the Philippine Islands, Census of the Philippine Islands, 1918, Vol. IV, Part II: Schools, Universities, Commerce and Transportation, Banks and Insurance (Manila: Bureau of Printing, 1921), p. 602.

[18] In the same year, the University conferred a total of 172 degrees with the following distribution: Bachelor of Arts (83), Bachelor of Agriculture (15), Graduate in Pharmacy (4), Bachelor of Science (12), Bachelor of Laws (34), Master of Arts (2) Civil Engineering (2), Doctor of Veterinary Medicine (2), Doctor of Medicine (16) and Doctor of Tropical Medicine (2). See ibid., p. 608.

gradually replaced by Filipinos. For example, in 1920, Filipino Ph.D. graduates of U.S. universities took over the Department of Agricultural Chemistry in the College of Agriculture. By December 1926, the university's enrollment in all colleges had reached 6,464 and out of a total teaching staff of 463, only 44 were Americans and other foreigners.[19]

Before 1910, the American colonial government encouraged young men and women to get higher professional education as much as possible in American colleges. In 1903, the Philippine Commission passed an Act to finance the sending of 125 boys and girls of high school age to the United States to be educated as teachers, engineers, physicians and lawyers.[20] One third of these were chosen by the governor-general on a nation-wide basis and the rest by the provincial authorities. In exchange for this privilege, the *pensionados*, as they came to be called, were to serve in the public service for five years after their return from their studies. Between 1903 and 1912, 209 men and women were educated under

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[19] Findings of the Monroe Survey of Education in the Philippines cited in Forbes, *op. cit.*, p. 477. The University began in 1911 with a faculty of only 36 scholars with the rank of assistant professor or higher, of which only five (14 per cent) were Filipinos, mostly from the College of Medicine. The remaining members of the faculty were Americans or in one or two cases other foreign professionals. In 1925, of 150 faculty members with the rank of assistant professor or higher, 117 (78 per cent) were Filipinos and 33 (22 per cent) were American or other foreign scholars. See Harry L. Case and Robert A. Bunnell, *The University of the Philippines; External Assistance and Development* (East Lansing, Michigan: Institute for International Studies in Education, Michigan State University, 1970), p. 10, Table 1.

[20] Forbes, *op. cit.*, p. 457.

this program in American schools.[21] After the establishment of the University of the Philippines, scholarships for advanced studies of a scientific or technical nature in American universities were given only in preparation for assignment to jobs in the public service.

The Philippine Commission introduced science subjects and industrial and vocational education into the Philippine school system but they found that industrial and vocational courses were very unpopular with the Filipinos. When the Manila Trade School was opened in 1901, the school authorities found it difficult to get students to enroll in these courses. Because of their almost 400 years of colonial experience under the Spaniards, middle class Filipinos had developed a general disdain for manual work and a preference for the prestigious professions of the time, namely, the priesthood, law and medicine. Education in these professions came to be regarded as the means of making the best of the limited opportunities in the Spanish colonial bureaucracy and thus of rising from one's social class. Hence, even at the newly-opened University of the Philippines, it was difficult to get students to enroll in courses which required field work such as, for example, agriculture, veterinary medicine, engineering and other applied sciences. Scholarships were thus offered by the government to attract a sufficient number of students to enroll in courses that were needed to fill up the technical positions in the government service. As one of the members of the

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[21] Charles Burke Elliott, The Philippines to the End of the Commission Government: A Study in Tropical Democracy (New York: Greenwood Press Publishers, 1968), p. 242. The author served as Secretary of Commerce and Police in the Philippine Commission from 1910-1912.

Philippine Commission observed at that time, the situation was not very different from what was happening in the United States where students crowded into the schools to get an education in the learned professions. As he put it: "The great educational problem is to induce all but the select few to believe that business, industrial and especially agricultural life, offer careers as honorable, as dignified and as profitable as the learned professions."[22]

In the field of medicine, the Philippine Commission provided for as many scholarships as there were regularly organized provinces in the Islands. These were awarded by the school departments after competitive examinations in the provinces.[23] A recipient of these scholarships was required to return to the province from whence he came and to serve as a physician for as many years as his medical education was paid for by the government. This policy was adopted not only to assure the medical school a continuing supply of carefully selected students but also

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[22] Ibid., p. 238. A change in the Filipino attitude towards manual work was observed by Hugo Miller during the second decade of American rule. As he wrote:

> In the last few years the Filipino's ideas of manual labor have changed greatly....In the schools and industrial exhibits the dignity and value of work have been emphasized. When the common schools were first established in the Philippines under the American regime, family servants often carried the pupils' books to school. Students generally expressed great distaste for any kind of industrial work. This was a reflection of the ideas of their parents on the aims of education and the dignity of labor. Today, however, this dislike for industrial instruction is not evident even with respect to such forms as gardening and growing corn. See his Economic Conditions in the Philippines, Rev. ed. (Boston: Ginn and Company, 1920), p. 304.

[23] Philippine Commission, Act No. 1632, 25 April 1907, in Forbes, op. cit., p. 354.

to ensure a balanced geographical distribution of physicians in the different provinces and to counteract their tendency to settle in the large urban areas.

Selected graduates of the schools of medicine and nursing were also sent on government scholarships to universities in the United States for postgraduate courses and training in special fields. In 1921, the Rockefeller Foundation provided for six fellowships for qualified Filipinos in universities in the United States and Europe, two each in the fields of public health (preventive medicine), public health laboratory work and teacher training in nursing education.[24] Over several years, the Foundation provided more than thirty of these fellowships and also financed shorter observation trips of many other health officials. It also greatly aided in the establishment and development of the Graduate School of Public Health and Hygiene in the University of the Philippines.[25]

When the Bureau of Public Works was created in 1901, the Americans found that there were no competent Filipino engineers, and American engineers had to be imported. As a consequence, a special effort was made to attract Filipinos to pursue advanced studies leading to careers as engineers. In many cases government financial assistance was provided to enable them to complete their professional studies in the United States. Upon achieving their professional qualifications they were employed as junior engineers in the Bureau of Public Works. Many of them rapidly

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[24] _Ibid._, p. 361.

[25] Joseph Ralston Hayden, _The Philippines: A Study in National Development_ (New York: The Macmillan Co., 1942), pp. 644-645.

advanced in their positions. Their career progress can be seen from the fact that whereas in 1913 there were only 18 Filipino engineers out of a total of 145 engineers in the Bureau of Public Works, the rest being American; by the end of 1925, out of 190 engineers in the Bureau, only 16 were Americans and 174 were Filipinos.[26]

As can be seen from this survey of early American policies for higher education, the establishment of the University of the Philippines satisfied the short-run needs for professionally trained Filipinos in the colonial government's organization and programs. What the authorities did not recognize was that by providing for an extensive public school system at the elementary and secondary levels they had increased tremendously the social demand for professional education. The University of the Philippines remained the only publicly-supported institution for higher education, and, since it could not meet the increasing social demand for university education,the establishment of other colleges and universities was left to the initiative of enterprising Filipinos. For many Filipinos, private education became the alternative for professional education.

Many of the existing private nonsectarian universities were organized during the early period of the American regime to help meet the increasing demand for professional education and the country's need for trained manpower. At the same time, these schools remained distinctively Filipino in orientation as they were conceived by their founders as a

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[26]Only one Filipino engineer, however, held the post of Director of Public Works during the first 25 years of American civil government. He was Jose Paez and held the position of Director from 1919 to 1924. In 1924, he resigned to become President of the Manila Railroad Company and was replaced by an American engineer. Paez had pursued advanced engineering studies in the United States and Europe at his own expense. See Forbes, *op. cit.*, p. 408.

means to conserve the national heritage and prevent the complete Americanization of the Filipinos. In the words of the founder of one of these schools, they were

> established for the purpose of providing enlightenment to the masses and at the same time to keep intact and conserve Filipino ideals. The private schools rendered to the country an invaluable service. They served at that time as the wall of contention against the danger of the complete Americanization of the Islands. No one can deny that without these positive manifestations, the moral, social and intellectual contexture of Filipinos today would have suffered changes which today would be greatly deplored.[27]

Some of these schools were the Liceo de Manila, now Manila Central University, which was organized by the Sociedad Filomatica in 1900, the Colegio Filipino established in 1900 and which became the National University in 1921, the Instituto de Manila in 1913 which became the University of Manila in 1929, the Centro Escolar de Señoritas founded in 1910 which became the Centro Escolar University in 1930 and the Philippine Women's College founded in 1919 which became a university in 1932.[28]

Two existing Protestant-run universities -- Silliman University

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[27] M.V. de los Santos, quoted in Hayden, *op. cit.*, pp. 554. De los Santos organized the University of Manila.

[28] Antonio Isidro and Maximo D. Ramos, *Private Colleges and Universities in the Philippines* (Quezon City: Alemar's, 1973), pp. 15-20. Hayden described the goals of the Philippine Women's University thus:

> The University seeks to preserve beneath a modern exterior the fundamental womanly virtues and charm which are typical of the *Filipina*, and at the same time to prepare its students for the broader and more active role which women now play in Philippine society. In striving to accomplish these purposes it combines the social training of the "finishing school" with the academic excellence and serious purpose of the women's college. (*op. cit.*, p. 558).

in Dumaguete City and Central Philippine University in Iloilo City -- were also founded during the first decade of the American regime. They began as mission schools and gradually evolved into their present status.[29]

At the outset of the American regime, there was no definite government policy on private schools. Because of the widespread disorganization that followed as more of these schools were set up, government regulation and control was found necessary. This was meant to guarantee that minimum standards of education which were then necessary for the preparation of students for the duties of citizenship would be maintained and to ensure that the enthusiasm of the people for education would not be exploited by institutions which were operating only for profit.[30]

The first attempt to regulate private schools was through the Corporation Law (Act No. 1459) enacted by the Philippine Commission in 1906. It provided that any group can establish a school or college by forming a corporation. The articles of incorporation must specify, among others, the proposed name of the school or college, its location, the number and qualifications of the trustees, the amount of money or description of property to be used in support of the institution. The law also provided that such an incorporated institution can grant diplomas and confer degrees only upon approval by the Secretary of Public Instruction (later on Secretary of Education). In effect, it treated the schools

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[29] Silliman University was founded by the Board of Foreign Missions of the Presbyterian Church in the United States and became a university in 1935. Central Philippine University was similarly established by the American Baptist Foreign Mission Society and gained university status in 1953.

[30] Isidro and Ramos, _op. cit._, pp. 22-23.

like commercial firms or business enterprises except that they would be under the supervision of the Department of Public Instruction rather than the Department of Trade and Industry.

The first private school was incorporated in 1908 and this number rapidly grew. The government, therefore, found it necessary to set up a special agency to supervise them. The position of Superintendent of Private Schools was created by the Secretary of Public Instruction to supervise the incorporated schools. In 1917, Act No. 2076 (Private School Act) was enacted by the Philippine Legislature. The Act recognized private schools as educational institutions and not commercial ventures. It required the Secretary of Public Instruction to "maintain a general standard of efficiency in all private schools and colleges so that ... (they shall) furnish adequate instruction to the public..." and authorized him to "inspect and watch" these schools and colleges. The supervision of these schools was entrusted to a staff of four within the Department of Public Instruction -- a superintendent, an assistant superintendent and two supervisors.

The number of private colleges increased rapidly. In 1925, a survey of the educational system of the Islands was authorized by the Philippine Legislature.[31] The Board of Educational Survey which was headed by Paul Monroe made a comprehensive investigation of all public and private institutions of learning in the country. The Monroe Survey found most private schools substandard. It reported that most of these were physically ill-equipped and with more part-time than full-time faculty members. Among the private colleges and universities, it found

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[31]Act No. 3162, 8 March 1924. See Forbes, _op_. _cit_., p. 435.

out that

> The major part of their...work is conducted at night and it was inspiring and yet pathetic to see the large number of these eager young men and women crowded in badly lighted, badly ventilated rooms, often having difficulty to distinguish the teacher's voice from the street. The equipment of all these institutions is woefully inadequate, the laboratory for the teaching of science being but a caricature of the real thing.[32]

As a consequence of the findings of the Monroe Survey, the Government took steps to improve the machinery for the supervision of private schools. The Philippine Legislature created the Office of Private Education headed by a Commissioner of Private Education who was assisted by six supervisors. The work of the Commissioner's office included supervision or inspection of schools, i.e. to look into such matters as physical plant, school facilities, libraries, laboratory equipment and student load, and administrative work such as enforcement of relevant government regulations, evaluating credits taken by students, managing admission of foreign students and the like. As a result of the increased outlay for supervision of private schools, their standards were improved. For example, some 250 courses previously granted recognition by the Government were withdrawn. In 1932, however, the Reorganization Act reduced the Office of Private Education into a mere division within the Department of Public Instruction. The position of Commissioner for Private Education was abolished.

The number of private schools continued to increase during the American regime. In 1932, the Commissioner of Private Education

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[32] Quoted in Isidro and Ramos, op. cit., p. 21.

estimated that the government would have to expend at least ₱10,750,886 each year exclusive of the cost of additional buildings and equipment if it were to accomodate the students enrolled in recognized private institutions. This was more than what was then being appropriated for the maintenance of the Bureau of Education and the University of the Philippines. As one American official at that time noted, "the private schools in the aggregate are 'big business' and they supplement the public educational system by providing facilities which thus far the government has not had the funds to supply."[33]

The Commonwealth Period

In 1935, the Philippine Commonwealth was inaugurated and ushered in a period of transition to political independence. The Constitution acknowledged the importance of promoting scientific development for the economic development of the country by incorporating a provision (Article XIII, Section 4) declaring that "The State shall promote scientific research and invention. Arts and letters shall be under its patronage..."

The government, which was by this time completely under Filipino management, continued to expand its public school system and worked towards the development of its economic base in preparation for the country's independence. The Commonwealth's policy was to accomodate all children of school age in the primary schools in contrast to the American educators' emphasis on the maintenance of quality education. As school facilities could not cope with the annual increase in the number of children eligible for admission under the new policy of total accomodation, the Government abolished Grade VII as the terminal grade in the

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[33]Hayden, op. cit., p. 549.

elementary curriculum. This was embodied in the Education Act of 1940.[34] Moreover, the "double-single session" plan was instituted by reducing the time allotment or dropping of certain subjects in the elementary school curricula. This allowed the accomodation of two groups of children in each school room -- one in the morning and another group of the same grade in the afternoon. Accomodation was thus doubled with the same physical facilities but at the expense of the quality of instruction.

With respect to the regulation of private schools and colleges, Commonwealth Act No. 180 (13 November 1936) repealed the Reorganization Law of 1932 and reestablished the Office of Private Education. Headed by a Director, its task was to maintain on behalf of the Secretary of Public Instruction, a general standard of efficiency of instruction in all private schools and colleges and to supervise, inspect and regulate these. Moreoever, the Act (which is still in force) prescribes (Section 3) the minimum requirements that must be fulfilled by an institution, in order to be granted a university status. These are: (1) the operation of recognized postgraduate course in liberal arts and sciences or in education leading to a master's degree, (2) the operation of a four-year undergraduate course in liberal arts and sciences, (3) the operation of at least three professional colleges, and (4) the posession and maintenance of a professionally administered library of at least ten thousand volumes of collegiate books. In addition to these, the Secretary of Public Instruction may prescribe other regulations on the granting of university status.

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[34] Commonwealth Act No. 589, 19 August 1940.

By 1938, there were 425 private schools recognized by the government. Sixty-four of these were institutions at the college level, seven of which were universities. These were Centro Escolar University with an enrollment of 781 students, Far Eastern University with 3,941 students, National University with 1,283 students, Philippine Women's University with 492 students, Silliman University with 646 students, University of Manila with 1,544 and the University of Santo Tomas with 4,493. The total enrollment of private universities that year was 13,180. The University of the Philippines had 6,395, making up a total of 19,575 college students in all universities in the country.[35] The combined facilities of all these universities contributed to the significant increase in trained scientists and engineers in the Philippines before the Second World War. This may be seen in Table III-1.

The occupation of the Philippines by the Japanese during World War II brought educational and scientific activities practically to a halt as able bodied citizens joined the resistance movement. Worse still, much of the country was reduced to ruins during the battles fought for its liberation in 1944-45. Manila, which was the center of all educational and scientific activities, was razed to the ground, destroying everything that had been built up before. It was in this condition that the Philippines became an independent state. The government had to contend with economic reconstruction, normalization of operations as well as the task of planning the direction of economic development.

In the field of education, the period immediately following 1945 saw an enormous swelling of school age population in all levels of edu-

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[35]Isidro and Ramos, op. cit., p. 23.

Table III-1
Growth in the Number of Selected Professions, 1903-1939

Year	1903		1939	
Total Population of the Philippines	Number		Number	% Increase
	7,635,426		16,000,303	109.5
Persons in the Professional Service	Number	As % of Population	Number	As % of Population
	25,637	.33	103,415[a]	.65
Selected Professions	Number		Number	
Dentists and Opticians	38[b]		6,483	
Physicians and Surgeons	1,604		4,409	
Pharmacists and Druggists	n.d.		6,584	
Engineers	108[c]		5,054	
Trained Nurses	331[d]		5,265	
Professors and College Instructors	n.d.		14,870[e]	
Lawyers, Judges and Fiscals	862[f]		3,154	
Veterinary Surgeons	37		n.d.	

Sources of data: United States, Bureau of the Census, Census of the Philippine Islands, 1903, Vol. II, Population (Washington, D.C.: Government Printing Office, 1905), p. 14; Table 53, p. 865, Table 55, p. 883 and Table 59, pp. 985-987; Commonwealth of the Philippines, Commission of the Census, Census of the Philippines, 1939, Vol. II, Summary for the Philippines and General Report for the Censuses of Population and Agriculture (Manila: Bureau of Printing, 1941), pp. 484, 487-488.

[a]Probably exaggerated as it includes persons engaged in various professions regardless of the industry they were employed in. However, only those who were actually engaged in actual practice were classified under each profession. Persons with professional qualifications but not actually following their profession were not counted.

[b]Includes dentists only.

[c]The number includes civil engineers and surveyors. Another category in the census data which was excluded from the above table was for engineers and firemen which numbered 1,924.

[d]Included midwives.

[e]Included persons engaged in recreational occupations.

[f]Lawyers only.

cation -- elementary, secondary and collegiate. This was the result of the war which had disrupted the normal operation of schools for several years. Parents were reluctant to send their children to Japanese-run schools. The constant evacuation of the population to safer areas meant no schooling for many students for about three to four years. Thus at the end of World War II, there was practically a stampede of students to existing schools to resume their education. With the country in ruins, and the Government unable to meet the great demand for education, private institutions were rapidly organized to provide for the school needs. The number of private universities and colleges increased further. It is against this background that the development of government policy for the education of scientists, engineers and physicians must be examined.

The Present Structure

When the Philippines achieved its independence in July 1946, the University of the Philippines was the only state-supported university. By 1949, the Philippine Normal School had become a state college. This was followed by the creation of the Philippine College of Commerce in 1952. By school year 1955-56 there were already seven state colleges in operation and one state university. On 18 June 1955, the President signed into law Republic Act No. 1387, creating the Mindanao State University which started operating in 1962.

By 1959-60, the seven state colleges and the University of the Philippines had a total enrollment of 22,216. This increased to 19 state colleges and universities with an aggregate enrollment of 42,621 by 1964-65. By 1969-70, this number had reached 26 with a total enrollment of 54,173.

Table III-2
Growth of State Universities and Colleges
School Years 1959-60 to 1969-70

Institution	School Years				
	1959-60	1964-65		1969-70	
	No.	No.	% Increase	No.	% Increase
Universities	1	3	200	7	133
Colleges	7	16	128	19	19
Total	8	19	137	26	37
Total Enrollment, Collegiate Level	22,216	42,621	92	54,173	27

Sources of data: Department of Education, Board of National Education, School Statistics, School Year 1966-67 (mimeo.), p. 17, School Statistics, 1970-71, (mimeo.), p. 12; Office of Coordinator for State Colleges and Universities, unpublished statistics.

As of school year 1975-76, there are eight state universities and 35 state colleges operating throughout the country.[36] These are unevenly distributed in the various regions. Except for the University of the Philippines, Mindanao State University and the Pamantasan ng Lungsod ng Maynila (Manila City University), which were founded as universities by charter, the existing state universities began either as agricultural schools (e.g., Central Luzon State University and Central Mindanao University) or trade/technical schools (e.g. University of Eastern Philippines) and were later converted into universities by Acts of the Congress. State colleges started in a similar manner, being originally agricultural or vocational/technical schools which have been given individual charters by laws passed by Congress. These charters enable the universities and colleges to operate with far greater autonomy, especially with respect to curriculum and program planning, than other state-supported schools and

[36]Data from the Department of Education and Culture, Office of Coordinator for State Colleges and Universities.

colleges. These provide the framework within which the university or college functions, specify the degrees and courses it should offer, the colleges or units that will be part of the institution, the composition of its governing board, its powers and functions, and other matters. State colleges and universities are linked to the Department of Education and Culture (DEC) through the Office of Coordinator for State Colleges and Universities under the Office of the Secretary of the DEC.

Despite the rapid growth in the number of state universities and colleges, the government's share in providing higher education for the country is quite small. As shown by the Presidential Commission to Survey Philippine Education in 1970, the government's support for public education is concentrated at the elementary level where 96 per cent of all elementary school children are enrolled. It provided higher education for only 8 per cent of the total collegiate population (6 per cent in state colleges and universities and the remaining 2 per cent in community colleges, vocational/trade schools directly under the supervision and control of the DEC) while private colleges and universities provided the remaining 92 per cent. This can be seen from Table III-3.

Table III-3
Ratio of Total Student Enrollment by Levels and Sectors, 1969

Levels	Public	Private
Elementary	96%	4%
Secondary	36%	64%
Collegiate	8%	92%

Source of Data: Presidential Commission to Survey Philippine Education, Education for National Development: New Patterns, New Directions; Philippine Education Survey Report, Vol. 2 (Manila: December 1970), p. 45.

Rationale for the Creation of State Universities and Colleges

When the Constitution was drafted in 1935 the responsibility of the state to provide education for its citizens was guaranteed.[37] The demand for more institutions to train the professional and technical manpower needed for economic development both in the government service and in the private sector increased greatly. It was logical, therefore, that the government would assume additional responsibility for higher education. The postwar creation of additional state universities and colleges reflects the government's acceptance of this responsibility.

In 1955, the Congress provided for the creation of a second state university, the Mindanao State University in Marawi City, an institution that would help to accelerate the integration of the Muslims and other cultural minorities in the Philippines into the body politic,[38] and provide the necessary professional and technical training that would help to hasten the socioeconomic development of the Minsupala Region, i.e., the islands of Mindanao, Palawan and Sulu. The University opened in June 1962.

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[37] Thus, Article XIII, section 5, provided that:

> All educational institutions shall be under the supervision of and subject to regulation by the State. The Government shall establish and maintain a complete and adequate system of public education, and shall provide at least free public primary instruction and citizenship training to adult citizens. All schools shall aim to develop moral character, personal discipline, civic conscience, and vocational efficiency, and to teach the duties of citizenship... Universities established by the State shall enjoy academic freedom. The State shall create scholarships in arts, science and letters for especially gifted citizens.

[38] Republic Act No.1387, 18 June 1955.

As a whole, however, the pattern that emerged from the postwar increase in the number of state universities and colleges reveals the absence of rational planning. The creation of these institutions has rarely been related to technical needs for manpower, regional considerations, or capabilities, that is, the adequacy of teaching staff, physical facilities and availability of funds. Politics appears to have been a major factor in the creation of many state colleges as well as in deciding on the annual appropriation of funds for their operation. As a then Undersecretary of Education has put it,

> A further mischief of the legislature is the old practice of converting by statute general high schools into vocational schools, or transforming ill-equipped, ill-staffed, and ill-financed vocational high schools into chartered colleges. This is an extremely cruel joke on the students and the community, who find they are no better, and most often worse off, on the day their poor schools take down the high school sign and put up the new college name. This practice was stopped only last year but vigilance is necessary.[39]

In 1954, a Board of National Education was created by Congress entrusted with the task of making policy decisions in education. Its members included the Secretary of Education, Chairman of the Senate Committee on Education, Chairman of the House Committee on Education, the President of the University of the Philippines, Chairman of the National Science Development Board, and representatives of the Catholic Educational Association of the Philippines, Association of Christian Schools and Colleges, Philippine Association of Colleges and Universities, Muslim and other Cultural Minorities Group.[40] Among its functions were

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[39] Onofre D. Corpuz, "Education in the Seventies" (Manila: Department of Education, November 1967, typescript), pp. 16-17.

[40] Republic Act No. 1124, 16 June 1954, as amended by Republic Act No. 4372, 18 June 1965.

to coordinate the objectives, functions and activities of different types and kinds of educational institutions in the country, to set up the general goals of accomplishments for the entire Philippine school system which would serve as a guide for the policies and functions of all educational institutions, and to compile educational statistics, keep records on education, conduct researches, surveys and studies on educational conditions and problems and evaluate the effects of national educational policies.[41]

From its creation, the Board of National Education (BNE) issued annual School Statistics which indicated trends in enrollment and graduates at all levels of education in the country, but it was unable to conduct researches, surveys or studies to evaluate educational policies. This is because, as one official put it, "Aside from its curiously improper name, it [had] no proper research or expert staff for studies, it [had] no financial resources to prove its ideas; and it [was] not even a proper debating society".[42] Thus the BNE was unable to function effectively as envisioned by the law that created it.

On 21 September 1972, Martial Law was declared in the Philippines and Congress was abolished. Legislation since then has taken the form of decrees and letters of instruction issued by the President. In 1973, the executive branch of the government was reorganized by Presidential Decree. This gave assent to the recommendations of a Presidential Commission on Reorganization.

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[41] Department of Education, Board of National Education, General Policies on Education, 1967-72 (Manila: Board of National Education, 1972), pp. 1-2.

[42] Corpuz, op. cit., p. 17.

Following the Integrated Reorganization Plan for the executive branch, the secretariat of the Board of National Education was abolished and transferred to the newly created Planning Service of the Department of Education and Culture. The Planning Service is now responsible for planning, research, project development and evaluation on education and culture.[43] Moreover, it also provides secretariat services for the Board. The Board itself has been renamed National Board of Education and has been relieved of the technical job of conducting its own research for planning and policy-making. The Reorganization Plan also provided for a moratorium on the creation of additional state colleges and universities without rational planning, study and recommendation by the Board.[44] This provision, however, has become redundant with the demise of Congress. Policy-making for higher education is now virtually in the hands of the Executive through the Department of Education and Culture.

In January 1973, a new Philippine Constitution was approved by the majority of the electorate in a referendum. Compared with the former Constitution, it is more emphatic in acknowledging the State's responsibility for the establishment and maintenance of an adequate system of education that would be relevant for national development. The goals of educational institutions in the Philippines are defined by the new Constitution as being the provision of an education that will not only develop patriotism and civic consciousness and moral character but also scientific, technological and vocational efficiency. Moreover, it as-

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[43] Presidential Commission on Reorganization, The Reorganization of the Executive Branch of the Philippine Government, Vol. I. The Integrated Reorganization Plan (Manila: Lawin Publishing House, Inc.,1973), pp. 144-146.

[44] Ibid., p. 144.

signs priority to the "advancement of science and technology" in national development.[45]

These constitutional provisions have served as important guides in the more recent policy-making for higher education especially as regards the state colleges and universities. There has been an attempt to rationalize, for example, their regional distribution as well as to relate their course offerings to regional needs for social and economic development and the existing facilities.

Regional Distribution of State Colleges and Universities

Existing state universities and colleges are unevenly distributed throughout the country. The largest concentration is understandably found in Region IV which includes Metropolitan Manila and the Southern Tagalog provinces. There are two state universities in this region, three

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[45]This can be seen in the following sections of the new Philippine Constitution:

Article XV - General Provisions

Sec. 8. (1) All educational institutions shall be under the supervision of, and subject to regulation by the State. The State shall establish and maintain a complete, adequate, and integrated system of education relevant to the goals of national development.

(2) All institutions of higher learning shall enjoy academic freedom.

x x x

(4) All educational institutions shall aim to inculcate love of country, teach the duties of citizenship, and develop moral character, personal discipline, and scientific, technological and vocational efficiency.

x x x

Sec. 9. (1) The State shall promote scientific research and invention. The advancement of science and technology shall have priority in the national development.

if the University of the Philippines at Los Baños is counted separately from the U.P. in Diliman, Quezon City. Both of these belong to the University of the Philippines System. There are nine state colleges in the region. There are three regions with only one state college each -- Region VI, West Visayas, Region VII, Central Visayas and Region IX, Western Mindanao. Region XI, Southeastern Mindanao, has no chartered state college or university. This can be seen from Table III-4.

State universities vary in size of collegiate enrollment, from 813 for the University of Northern Philippines in school year 1971-72 to 18,467 for the University of the Philippines in the same year. Among the state colleges, sizes of enrollment range from 130 at the Palawan National Agricultural College to 15,207 at the Philippine College of Commerce during school year 1971-72. The universities and colleges located in Region IV tend to have the largest enrollments.

Table III-4
Distribution of State Universities and Colleges
By Region, School Year 1975-76

Region	Universities	Colleges	Total
I. Ilocos Region	1	5	6
II. Cagayan Valley	0	5	5
III. Central Luzon	1	5	6
IV. Metro Manila Area and Southern Tagalog Provinces	2	9	11
V. Bicol Region	1	1	2
VI. Western Visayas	0	1	1
VII. Central Visayas	0	1	1
VIII. Eastern Visayas	1	5	6
IX. Western Mindanao	0	1	1
X. Northern Mindanao	1	1	2
XI. Southern Mindanao	0	0	0
XII. Eastern Mindanao	1	1	2
Total	8	35	43

Source of Data: Department of Education and Culture, Planning Service.

University of the Philippines System

As the oldest among the eight state universities, the University of the Philippines offers the most extensive degree courses at both the undergraduate and graduate levels. On 20 November 1972, the U.P. was converted into a University of the Philippines System by Presidential Decree No. 58. By virtue of this decree, the College of Agriculture at Los Baños became an autonomous university of the System headed by a chancellor. Agriculture and forestry continues to be a distinctive area of competence of the U.P. at Los Baños but it is trying to develop other areas as well.

The U.P. System has other colleges in different regions of the country -- Manila, Baguio, Cebu, Pampanga, Iloilo and Tacloban. The entire university system as of June 1975 had 36 colleges, schools and institutes. It had 114 undergraduate programs leading to baccalaureate degrees and 14 undergraduate diploma or certificate programs. At the graduate level, it had 144 programs leading to master's degrees, 29 programs leading to doctoral degrees and 13 graduate degree certificate programs.[46] Its doctoral programs include the agricultural sciences, environmental sciences, botany, geology, pharmacy, food science, statistics and other fields.

The U.P. System's teaching force in 1974-75 consisted of 2,173 faculty members. Of this number, 392 or 18 per cent had doctoral degrees, 757 or 34.8 per cent had master's degrees, 965 or 44.4 per cent had

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[46] University of the Philippines, Office of the President, "The U.P. System and the Future: A Perspective Development Plan," (February 1976, mimeo.), Annex G: Present Services, Resources and Capabilities.

Bachelor's (B.S. or B.A.) degrees and 59 or 2.7 per cent had other professional degrees.[47] At the U.P. at Los Baños, for example, a survey of 397 faculty members showed that 126 had Ph.D. degrees and 119 had master's degrees. Most of those with doctoral degrees were in the biological sciences. This can be seen from Table III-5. Because of the availability

Table III-5
Faculty Profile, University of the Philippines
At Los Baños, School Year 1976-77

Number of Faculty Members with Degrees	Fields of Specialization							
	Social Science		Physical Science		Biological Science		Total	
	No.	%	No.	%	No.	%	No.	%
B.A./B.S. degrees	48	36.1	50	60.2	54	29.8	152	38.3
M.A./M.S. degrees	60	45.1	19	22.9	40	22.1	119	30.0
Ph.D. degrees	25	18.8	14	16.9	87	48.1	126	31.7
Total	133	100.0	83	100.0	181	100.0	397	100.0

Source of Data: Center for Policy and Development Studies, University of the Philippines at Los Baños, Unpublished Faculty Survey, 1977.

of a large number of highly trained faculty, the U.P. System has retained its leadership in instruction and research in the sciences.

Mindanao State University

The second university created by the government is Mindanao State University (MSU). Located in Marawi City in Mindanao, it began having classes in school year 1962-63. During academic year 1970-71, it had an enrollment of 1,798. As of June 1974, it had 10 colleges, 4 institutes and one center offering various degree programs. It had a total of 31 undergraduate programs leading to the baccalaureate degree and four two-

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[47] Ibid.

year undergraduate diploma or certificate programs. At the graduate level, it had three programs leading to the master's degree. The bachelor's degree programs include three in the agricultural sciences, four in engineering, three in fisheries, one in forestry and five in the natural sciences.[48] It has also begun to offer the first two years of the undergraduate programs leading to bachelor's degrees in nursing, pharmacy and doctor's degrees in veterinary medicine and dental medicine. Two of its graduate programs are the Master of Arts in Teaching, major in physics and the Master of Science in Physics.

As of school year 1974-75, MSU's teaching staff totaled 367.[49] Of this, five had doctoral degrees (1.4 per cent), 112 had master's degrees (30.5 per cent) and the rest, 250, had bachelor's degrees (68.1 per cent). Of the 112 faculty members with master's degrees, 16 specialized in different branches of engineering and 15 are in the natural sciences. Of the five Ph.D. holders, there was one each in mathematics, physics and anthropology and two in education.

Central Luzon State University

Central Luzon State University (CLSU) is an example of an institution that began as an agricultural school during the American Regime. Established on 12 April 1907, it grew into an agricultural high school and became a model for 50 other schools that were created all over the

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[48] Mindanao State University, University Catalogue, 1974-75 (Marawi City: 1974).

[49] Ibid.

archipelago. It became a college in 1950[50] and was chartered as a university by Republic Act No. 4067 on 18 June 1964. The Act provided that it "shall primarily give professional and technical training in agriculture and mechanical arts besides providing instruction and promoting research in literature, philosophy, the sciences, technology and the arts."

Situated in Muñoz, Nueva Ecija, some 151 kilometers north of Manila, CLSU had an enrollment of 1,756 students in school year 1970-71. It had five colleges in school year 1974-75 offering eight undergraduate programs leading to a Bachelor's degree in agriculture, agricultural engineering, agricultural education, elementary education, agricultural extension, home economics, home industry and agribusiness. It has three graduate programs leading to the master of science in agricultural education, horticulture and dairy production.

As of December 1975, CLSU's catalogue listed a total of 200 teaching staff.[51] Eleven of these were holders of doctoral degrees (5.5 per cent), 57 had master's degrees (28.5 per cent) and 132 had bachelor's degrees (66 per cent). Most of those with graduate degrees specialized in the agricultural sciences or engineering.

Other State Universities and Colleges

Four other state universities have a similar concentration of course offerings as CLSU. This can be traced back to their origins as primarily agricultural or teacher-training schools before they were given

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[50] By virtue of Executive Order No. 393 issued by President Elpidio Quirino on 31 December 1950.

[51] Central Luzon State University, General Catalogue, 1974-75 (Muñoz, Nueva Ecija: December 1975, mimeo.).

university charters. The exception is the Pamantasan ng Lungsod ng Maynila (Manila City University) which offers a variety of professional courses and which like the Mindanao State University originated as a chartered university.

Among the 35 chartered state colleges, there are 10 which are mainly engineering or technological schools, 15 which are mainly agricultural and 10 which are mainly teacher-training schools. Among the predominantly teacher-training schools, the West Visayas State College is unique as it has opened a school of medicine in June 1975. It is the only state-supported school offering the doctor of medicine degree outside of the U.P. System. One state college specializes in training the country's merchant marine and another specializes in programs in commerce, business administration and commercial education.

This pattern of specialization of courses among the state colleges can be traced back to their historical origins. They began as agricultural secondary schools, teacher-training schools or trades/vocational schools and were later on converted into chartered colleges by laws passed by the defunct Congress or more recently by the issuance of a presidential decree. Moreover, this pattern also reflects the fact that many of these institutions have not yet been able to reorient their programs to the expanded role in their respective regions that has been assigned to them by law.

Organization of State Universities and Colleges

State universities and colleges are governed by their respective Board of Regents or Board of Trustees. With the exception of the University of Northern Philippines, the Isabela State College of Agriculture and the Pamantasan ng Lungsod ng Maynila, the Secretary of the Department of Education and Culture sits as the chairman of these various boards. Because of the sheer number of the state universities and colleges, however, he seldom can attend all these meetings and often sends a representative. As such he has very little influence over their policies and programs. The boards of regents/trustees decide on the programs and courses of studies, recruitment and promotion of faculty members, appropriation of money for various units and programs of the university/college, rules governing admission of students, their conduct, the conferment of degrees, creation of professorial chairs and the like. Administration of the university/college affairs is usually vested in a President. The members of the faculty sitting in a university or college council recommend courses, programs, rules, requirements, and others to be followed in the institution which are then decided upon by its Board of Regents or Trustees.

Budget for State Universities and Colleges

Financial support for these institutions comes mainly from the National Government. Roughly 83 per cent of their income comes from the government and 17 per cent comes from tuition fees and other earnings of the institution.[52] From school year 1960-61 to 1969-70, the National Government appropriated an annual average of 2.3 per cent of its total budget for state universities and colleges. In 1960-61, the share of state universities and colleges was 2.0 per cent of the National Government's budget or ₱21,280,630 out of ₱1,092,919,070. This gradually increased to 4.0 per cent of the National Government's budget for 1969-70 or ₱134,262,000 out of the total budget of ₱3,323,698,915.[53]

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[52] Presidential Study Committee on State Higher Education, Technical Staff, Towards the Integration of Higher Education in the Philippines; Preliminary Report (Manila: 1975, mimeo.), pp. 37-38.

[53] Presidential Commission to Survey Philippine Education, A Report on Educational Finance in the Philippines (Manila: 1970, mimeo.), Appendices, Tables 1-3.

In 1975, state universities and colleges got ₱374,181,000 or 2.0 per cent of total national government expenditures of ₱19,049,145,000.[54]

The national government's financial support for the state universities and colleges varies with their size and programs. Among those institutions of similar size, the disparities in appropriation can partly be traced to the "aggressiveness and enthusiasm of the leadership in each state college."[55] The U.P. System gets the biggest share of the appropriations for state universities followed by Mindanao State University. In 1975, the U.P. System got ₱188,744,000 or 50.4 per cent of the total national expenditures of ₱374,181,000 for all state colleges and universities. Mindanao State University received the second biggest share, ₱47,449,000 or a quarter (25.1 per cent) of what the U.P. System got.[56]

Disparities in the appropriations for these institutions tend to be reflected in differences in pay scales for teaching staff as well as differences in available facilities. These affect the standards of instruction and research productivity in these institutions. The U.P. System has the highest pay scale among the universities, followed by the Mindanao State University. At the starting level of instructor I, for example, U.P. pays its staff ₱1,000 more than MSU and almost ₱4,000 more

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[54] Republic of the Philippines, Office of the President, Budget Commission, National Government Budget, January 1-December 31, 1977, Summary Tables, Table IV, pp. 24-28.

[55] Interview with the Coordinator for State Universities and Colleges, Department of Education and Culture, Manila, 4 March 1977.

[56] National Government Budget, loc. cit.

than the annual average pay of other state colleges and universities.[57] There is also a general disparity between average annual salaries of academic staff of state universities and colleges in the Metropolitan Manila area and those located outside it.

Private Universities and Colleges

As of school year 1975-76, there were 41 private universities and 461 colleges scattered all over the country. Sixteen of these universities are located in Metropolitan Manila, four are in Cebu City and three are in Iloilo City. Table III-6 shows the regional distribution of private universities and colleges in the Philippines.

Private universities and colleges in the Philippines may be classified into two broad groups according to organization, the sectarian and nonsectarian schools. The sectarian schools are made up of schools run by the Catholic religious orders or by the Protestant missions. Of the existing 41 universities, 12 are run by Catholic groups and two are run by the Protestants. Of the 468 private colleges and institutes, 184 are run by the Catholic orders.

The nonsectarian private schools are generally organized and managed like business enterprises. The Presidential Commission to Survey Philippine Education found in 1969 that 52 per cent of all private colleges and universities were operating for profit either as single proprietorships or as corporations.[58]

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[57] Presidential Study Committee on State Higher Education, op. cit., p. 54.

[58] Presidential Commission to Survey Philippine Education, Special Area Group for Higher Education, A Report on Higher Education in the Philippines (Manila: 1970, mimeo.), p. 42.

Table III-6
Distribution of Private Universities and Colleges
By Region, School Year 1975-76

Region	Universities		Colleges		Total, Universities and Colleges	
	No.	%	No.	%	No.	%
I. Ilocos Region	3	7.3	49	10.5	52	10.2
II. Cagayan Valley	0	0	19	4.1	19	3.7
III. Central Luzon	1	2.4	44	9.4	45	8.8
IV. Metro Manila Area and Southern Tagalog Provinces	17	41.5	130	27.8	147	28.9
V. Bicol Region	4	9.8	22	4.7	26	5.1
VI. Western Visayas (includes Iloilo City)	4	9.8	48	10.3	52	10.2
VII. Central Visayas (includes Cebu City)	7	17.1	26	5.6	33	6.4
VIII. Eastern Visayas	1	2.4	11	2.4	12	2.4
IX. Western Mindanao	0	0	13	2.8	13	2.6
X. Northern Mindanao	1	2.4	38	8.1	39	7.7
XI. Southern Mindanao	2	4.9	47	10.0	49	9.6
XII. Eastern Mindanao	1	2.4	21	4.5	22	4.3
Total	41	100.0	468	100.0	509	100.0

Source of Data: Department of Education and Culture, Planning Service, Project Development and Evaluation Division.

Details may not add up to totals due to rounding.

Standards of instruction vary a lot among private universities and colleges. Private sectarian schools tend to have higher standards of instruction as they manage to get external assistance to augment their income from tuition fees. This is, for example, true with universities run by the Jesuits (Ateneo de Manila University and Xavier University), the SVD Fathers (University of San Carlos and Divine Word University), the CICM Fathers (St. Louis University), the Dominicans (University of Santo Tomas) and the Protestant-run Silliman and Central Philippine Universities. These external assistance are often in the form of donations of laboratory equipment, library facilities, a program of exchange or visiting professors,[59] scholarships for faculty development, research funds and donations of professorial chairs. They can thus impose more selective admission requirements, lower faculty-student ratios unlike other private universities. In general, nonsectarian universities and colleges must encourage large enrollments to operate at a profit.

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[59]Interview with the Vice President for Finance at the University of San Carlos, Cebu City, 27 April 1977. He explained that the University has had visiting professors in marine biology from German universities through the German Academic Exchange Council, DAAD. They also get some help from MISEREOR, a Fund set up by the Catholic Bishops in Germany to assist educational programs in developing countries and some financial assistance from the Divine Word Society in Rome which they use to provide research/student assistantships in the natural sciences.

The CICM Fathers at St.Louis University in Baguio also get some assistance from MISEREOR as does the College of Agriculture at Xavier University. St. Louis University also has some visiting professors in the sciences coming from the Catholic University of Louvain in Brussels, Belgium. Data for St. Louis University are taken from its General Bulletin, 1976-77, pp. 3-5, and for Xavier University, interview with Rev. Fr. William Masterson, Dean of the College of Agriculture, Cagayan de Oro City, 20 April 1977.

Government Supervision of Private Universities and Colleges

Before September 1972, private universities and colleges were under the supervision of the Bureau of Private Schools (BPS) in the Department of Education. Headed by a Director, the BPS was responsible for granting permits to private schools to operate and offer courses, degree programs, collect tuition fees, and so on. The necessary permits were granted by the BPS after being satisfied that the schools had complied with the standards and requirements previously set up by the Bureau, for example, minimum laboratory facilities, faculty qualifications, a certain number of volumes in the library, and others. Government supervision of private universities and colleges, therefore, involved inspection and visitation of these schools, granting special orders for their students to graduate, validating credits earned by transferring students, approval of a college's petition to be granted university status, approval of tuition fee increases, and the like. The sheer number of the private schools and the lack of qualified staff in the Bureau of Private Schools, however, prevented the effective discharge of its functions. In the sciences, for example, it was not unusual for a BPS inspector not to have the necessary science background to evaluate a school's existing laboratory facilities.

Administrators of some of the more reputable schools complained that the government's attitude to private schools has been too restrictive.[60] They revealed that in many cases, approval by the Bureau of Private Schools had to be secured at every step of their program planning.

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[60] Interviews with the Presidents of Xavier University (Cagayan de Oro City) and Central Philippine University (Iloilo City), 20 and 25 April 1977, respectively.

This meant making frequent trips to Manila for the administrators to personally follow up the various permits that they needed. At the same time, they admitted that the government's tight supervision over private schools was also necessary because of the abuses of many schools whose main preccupation has been to make more profit, often at the expense of the established standards of education. They, however, contend that closer government supervision over private universities and colleges should be done selectively. For example, the government should do away with the highly centralized supervision over the academic programs of private universities and colleges with proven high standards.

With the Government Reorganization of 1972, the Bureau of Private Schools has been replaced by a Bureau of Higher Education which includes both private and public colleges under its purview. This has permitted a more integrated government supervision and control of all higher institutions of learning in the country as well as helped allay fears of discrimination on the part of the private schools. The Bureau of Higher Education performs mainly staff functions and operational details, i.e. inspection, granting of permits,and the like, are now delegated to the regional offices of the Department of Education and Culture.

Enrollment Patterns in Universities and Colleges

Statistics on the enrollment of college students in the various fields of specialization tend to reflect the pattern of predominant courses offered by colleges and universities in the country. As shown by Table III-7, in school year 1959-60, more than a quarter of the students in state colleges and universities were enrolled in education/ teacher training courses. In 1964-65 and 1969-70, this proportion increased tc over two-fifths of total enrollment in state colleges and universities. It will be recalled that many of the existing state colleges and universities started as teacher-training or agricultural schools.

The pattern of enrollment in private universities and colleges similarly shows the majority of students gravitating towards education/ teacher training and commerce/business administration courses. The reason for this is not hard to see as most private institutions derive their finances largely from tuition fees paid by students. Moreover, considering that most of these schools operate for profit, the most attractive courses to offer are the low-cost courses, i.e. those that do not require much capital and equipment outlay such as laboratory and library facilities. Thus, most private schools offer teacher-training, liberal arts and business administration/commerce courses. Only a few can afford to offer science and engineering degrees.

In general, enrollment in the sciences and engineering has remained low relative to the total number of students in all fields of study over the twelve-year period from 1959-60 to 1971-72. Over half (5,258 or 61.1 per cent) of all the students enrolled in agriculture in school year 1959-60 were found in state-supported schools. This proportion increased to 70.4 per cent (9,535 out of 13,552) in school year 1971-72. From 1959-60 to 1971-72, the number of students in state colleges and universities enrolled in agriculture grew by 81.3 per cent. However, as a proportion of the total enrollment in all fields in these schools, there has been little change. This pattern of enrollment reflects the fact that the majority of the country's schools offering agriculture degrees are public rather than private universities and colleges and these have been expanding over the years.

Table III-7*
Collegiate Enrollment in Universities and Colleges
By Field of Study, School Years 1960, 1965, 1970 and 1972

Field of Study	1959-60					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	5,258	15.2	3,342	2.5	8,600	5.2
B.S. Degree	4,787	13.9	2,447	1.9	7,234	4.4
Asso. Degree, Diploma,etc.[1]	92	0.3	-	-	92	Nil
Veterinary Medicine	379	1.1	895	0.7	1,274	0.8
Engineering and Technology[2]	6,341	18.4	16,158	12.3	22,499	13.6
B.S. Degree	1,549	4.5	15,473	11.8	17,022	10.3
Asso. Degree,Technical, Vocational[1]	4,792	14.0	685	0.5	5,477	3.3
Medical Sciences	1,384	4.0	21,577	16.4	22,961	13.9
B.S. Degree[3]	784	2.3	8,194	6.2	8,978	5.4
Dentistry (DDM)	41	0.1	2,273	1.7	2,314	1.4
Doctor of Medicine	559	1.6	10,396	7.9	10,955	6.6
Doctor of Optometry	-	-	582	0.4	582	0.4
Cert. of Midwifery, etc.[4]	-	-	132	0.1	132	0.1
Natural Sciences	2,209	6.4	15,631	11.9	17,840	10.8
Biological Sciences	1,795	5.2	13,512	10.3	15,307	9.2
Mathematics, Statistics and Physics	-	-	49	Nil	49	Nil
Chemistry	300	0.9	2,070	1.6	2,370	1.4
Geology	114	0.3	-	-	114	Nil
Teacher Training/Education	10,044	29.1	12,115	9.2	22,159	13.4
Liberal Arts and Social Sc.	4,927	14.3	13,586	10.4	18,513	11.2
Law and Foreign Service	828	2.4	7,701	5.9	8,529	5.1
Music and Fine Arts	319	0.9	815	0.6	1,134	0.7
Commerce and Business Admin.	2,446	7.1	38,672	29.5	41,118	24.8
Graduate Studies[5]	746	2.2	1,626	1.2	2,372	1.4
Total, All Fields	34,502	100.0	131,223	100.0	165,725	100.0

Sources of Data: Department of Education, Board of National Education, School Statistics (mimeo.), 1960-61; 1965-66; 1970-71; 1972-73.

Details may not add up to totals due to rounding. ND refers to no separate data.

[1]Requires less than four years to complete, education for technicians.

[2]Includes agricultural engineering.

[3]Includes the B.S. in Pharmacy, Industrial Pharmacy, Occupational Therapy, Nursing, Medical Technology and Hygiene.

[4]Includes Nursing (R.N.)

[5]No breakdown by fields of study.

*Table is continued next page.

Table III-7 (continued)*
Collegiate Enrollment in Universities and Colleges
By Field of Study, School Years 1960, 1965, 1970 and 1972

Field of Study	1964-65					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	6,890	13.5	3,475	0.9	10,365	2.5
B.S. Degree	6,435	12.7	3,320	0.9	9,755	2.3
Asso. Degree, Diploma,etc	77	0.1	-	-	77	Nil
Veterinary Medicine	378	0.7	155	Nil	533	0.1
Engineering and Technology	2,381	4.7	51,776	14.0	54,157	12.9
B.S. Degree	1,427	2.8	50,221	13.6	51,648	12.3
Asso. Degree, Technical, Vocational	954	1.9	1,555	0.4	2,509	0.6
Medical Sciences	3,888	7.6	35,606	9.6	39,494	9.4
B.S. Degree	517	1.0	19,827	5.4	20,344	4.8
Dentistry (DDM)	105	0.2	1,730	0.5	1,835	0.4
Doctor of Medicine	2,071	4.0	8,018	2.2	10,089	2.4
Doctor of Optometry	-	-	787	0.2	787	0.2
Cert. of Midwifery, etc.	1,195	2.3	5,244	1.4	6,439	1.5
Natural Sciences	689	1.3	6,529	1.8	7,218	1.7
Biological Sciences	285	0.6	2,447	0.7	2,732	0.6
Mathematics, Statistics and Physics	210	0.4	253	Nil	463	0.1
Chemistry	104	0.2	3,755	1.0	3,859	0.9
Geology	90	0.2	74	Nil	164	Nil
Teacher Training/Education	22,595	44.1	108,345	29.3	130,940	31.1
Liberal Arts and Social Sc.	6,311	12.3	52,702	14.2	59,013	14.0
Law and Foreign Service	922	1.8	8,760	2.4	9,682	2.3
Music and Fine Arts	284	0.6	2,070	0.6	2,354	0.6
Commerce and Business Admin.	5,402	10.5	94,582	25.6	99,984	23.7
Graduate Studies	1,833	3.6	6,146	1.7	7,979	2.0
Total, All Fields	51,195	100.0	369,991	100.0	421.186	100.0
Increase/(Decrease) Over Previous Total	16,693	48.4	238,768	182.0	255,461	154.1

*Table is continued next page.

Table III-7 (continued)*
Collegiate Enrollment in Universities and Colleges
By Field of Study, School Years 1960, 1965, 1970 and 1972

Field of Study	1969-70					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	6,963	12.1	2,852	0.5	9,815	1.5
B.S. Degree	6,285	11.0	2,420	0.4	8,705	1.4
Asso. Degree, Diploma,etc.	490	0.9	80	Nil	570	0.1
Veterinary Medicine	188	0.3	352	0.1	540	0.1
Engineering and Technology	3,484	6.1	60,980	10.5	64,464	10.1
B.S. Degree	ND	-	ND	-	ND	-
Asso. Degree, Technical, Vocational	ND	-	ND	-	ND	-
Medical Sciences	1,401	2.4	34,819	6.0	36,220	5.7
B.S. Degree	867	1.5	25,213	4.3	26,080	4.1
Dentistry (DDM)	87	0.2	771	0.1	858	0.1
Doctor of Medicine	447	0.8	6,654	1.1	7,101	1.1
Doctor of Optometry	-	-	603	0.1	603	0.1
Cert. of Midwifery, etc.	-	-	1,578	0.3	1,578	0.2
Natural Sciences	1,063	1.9	6,023	1.0	7,086	1.1
Biological Sciences	209	0.4	3,470	0.6	3,679	0.6
Mathematics, Statistics and Physics	408	0.7	475	0.1	883	0.1
Chemistry	422	0.7	2,046	0.4	2,468	0.4
Geology	24	Nil	32	Nil	56	Nil
Teacher Training/Education	24,468	42.7	149,565	25.7	174,033	27.3
Liberal Arts and Social Sc.	4,920	8.6	104,622	18.0	109,542	17.2
Law and Foreign Service	633	1.1	15,624	2.7	16,257	2.5
Music and Fine Arts	531	0.9	6,506	1.1	7,037	1.1
Commerce and Business Admin.	10,545	18.4	187,634	32.3	198,179	31.1
Graduate Studies	3,337	5.8	12,282	2.1	15,619	2.4
Total, All Fields	57,345	100.0	580,907	100.0	638,252	100.0
Increase/(Decrease) Over Previous Total	6,150	12.0	210,916	57.0	217,066	51.5

*Table is continued next page.

Table III-7 (continued)
Collegiate Enrollment in Universities and Colleges
By Field of Study, School Years 1960, 1965, 1970 and 1972

Field of Study	1971-72					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	9,535	11.9	4,017	0.6	13,552	1.9
B.S. Degree	8,202	10.3	3,445	0.5	11,647	1.6
Asso. Degree, Diploma, etc.	1,070	1.3	89	Nil	1,159	0.2
Veterinary Medicine	263	0.3	483	0.1	746	0.1
Engineering and Technology	12,863	16.1	76,019	12.1	88,882	12.5
B.S. Degree	5,009	6.3	74,532	11.9	79,541	11.2
Asso. Degree, Technical, Vocational	7,854	9.8	1,487	0.2	9,341	1.3
Medical Sciences	1,371	1.7	47,932	7.6	49,303	7.0
B.S. Degree	113	0.1	26,191	4.2	26,304	3.7
Dentistry (DDM)	94	0.1	1,025	0.2	1,119	0.2
Doctor of Medicine	459	0.6	5,322	0.8	5,781	0.8
Doctor of Optometry	-	-	840	0.1	840	0.1
Cert. of Midwifery, etc.	705	0.9	14,554	2.3	15,259	2.2
Natural Sciences	1,533	1.9	13,964	2.2	15,497	2.2
Biological Sciences	596	0.7	10,687	1.7	11,283	1.6
Mathematics, Statistics and Physics	469	0.6	504	0.1	973	0.1
Chemistry	468	0.6	2,773	0.4	3,241	0.5
Geology	ND	-	ND	-	ND	-
Teacher Training/Education	22,466	28.1	87,589	14.0	110,055	15.6
Liberal Arts and Social Sc.	6,068	7.6	112,542	17.9	118,610	16.8
Law and Foreign Service	574	0.7	15,037	2.4	15,611	2.2
Music and Fine Arts	606	0.8	7,013	1.1	7,619	1.1
Commerce and Business Admin.	17,209	21.5	245,062	39.0	262,271	37.1
Graduate Studies	7,647	9.6	18,413	2.9	26,060	3.7
Total, All Fields	79,872	100.0	627,588	100.0	707,460	100.0
Increase/(Decrease) Over Previous Total	22,527	39.3	46,681	8.0	69,208	10.8

Enrollment in engineering and technology decreased in the state-supported schools from school year 1959-60 to 1964-65 (from 6,341 to 2,381, a 62.5 per cent decline) but rose in 1969-70 (by 1,103 or 46.3 per cent over 1964-65) and reached 12,863 in 1971-72 (a jump of 269.2 per cent in two years). It will be noted from Table III-7, however, that many of those enrolled in engineering courses were working for the trade/ technical certificate or diploma rather than for the professional Bachelor's degree.

Among the private universities and colleges, enrollment in engineering and technology has been consistently rising, showing a jump of 220.4 per cent (from 16,158 to 51,776) from 1959-60 to 1964-65; a rise of 17.8 per cent from 1964-65 to 1969-70; and an increase of 24.7 per cent (from 60,980 to 76,019) from 1969-70 to 1971-72. On the whole, the overwhelming majority of the country's engineering students were enrolled in private universities and colleges. The proportion of engineering students in these schools in relation to the total in both public and private institutions were 71.8 per cent in 1959-60; 95.6 per cent in 1964-65; 94.6 per cent in 1969-70; and 85.5 per cent in 1971-72.

The number of students enrolled in the medical sciences has been declining over the years in both state-supported and private universities. This is especially noticeable among those taking the Doctor of Medicine (M.D.) degree in the private universities and colleges. In 1959-60, there were 10,396 students enrolled in this program in the private schools. This was reduced to 5,322 (a decrease of 48.8 per cent) in school year 1971-72. This enrollment trend has been the result of a successful campaign by the Philippine Medical Association (PMA) to raise standards of instruction in private medical schools by reducing the admission of freshmen students. This was deemed necessary in order to improve faculty/ student ratios and to increase the use of laboratory facilities by students.[61]

The bulk of the students enrolled for the B.S. degree in the field of medical science were in pharmacy. Unpublished statistics from the Board of National Education and the Bureau of Private Schools show that in school year 1959-60, there were 4,007 students in private universities and colleges enrolled for the B.S. in Pharmacy. This went down to 2,348 in 1964-65 (a decline of 39.2 per cent) and decreased further to 1,236 (a decline of 49.3 per cent from 1964-65) in school year 1969-70. In the ten-year period from 1959-60 to 1969-70, pharmacy students in private schools decreased by 69.2 per cent. This declining enrollment may be attributed to the changing functions of pharmacists. The need for them to perform the traditional function of dispensing prescriptions has been greatly reduced by the prepackaged products of the multinational pharmaceutical firms. Moreover, the small proprietary drug stores, particularly in the large urban areas, have been increasingly replaced by the drugstore-supermarket chains. There has, therefore, been an increasing demand for sales personnel and for detailmen to act as representatives,

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[61] This began in 1958 when the PMA proposed to the Board of Medical Examiners a ceiling of 2,700 incoming freshmen in all the private medical schools. The limits proposed were 1,000 for the University of Santo Tomas (UST), 700 for Far Eastern University, 300 for Manila Central University, 300 for the University of the East and 400 for medical schools outside Manila. As a result, 2,000 new students were prevented from entering medical schools in that year. In 1962, a new formula for admission was adopted by the Board of Medical Examiners which further reduced admission proportionately in various schools. UST's admission, for example, was cut down further from 650 to 475. See Robert Stauffer, The Development of an Interest Group: The Philippine Medical Association (Quezon City: University of the Philippines Press, 1966), pp. 37-38.

dealers and distributors of prepackaged pharmaceutical products. The Pharmacy Law of 1969, however, has provided that detailmen need not necessarily be graduates of pharmacy.[62] It can also be easily observed that most firms prefer to employ males for the job of detailmen. As the pharmacy profession in the Philippines has been traditionally dominated by women, this has resulted in their loss of employment opportunities, and hence, may explain the declining enrollment for pharmacy.[63]

The number of students in the natural sciences has remained small and even declined from 1959-60 to 1971-72. The decline in enrollment for the biological sciences may be related to the reduced quota of admission to the private medical colleges mentioned earlier. Students entering the college of medicine have, since 1959, been required to finish the Bachelor's degree (as a prerequisite for admission to the M.D. program) and most of them have chosen to major in the biological sciences. Table III-7, moreover, shows that there is a dearth of students majoring in mathematics, physics, statistics and in geology.

The enrollment figures show that relatively few students go into graduate studies although their number has been increasing over the years. An overwhelming majority of these students are in the field of education and the social sciences. This pattern reflects the fact that only a few schools in the country have the capability to offer graduate programs in the sciences and engineering. Most of these are

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[62] Republic Act No. 5921, 23 June 1969, Article III, Sec. 12, cited by Niño, _op. cit._, pp. 79-82.

[63] From 1947-48 to 1956-57, there were only 28 males out of every 100 pharmacy graduates. See _ibid._, p. 82.

at the Master's level. At present, only the University of the Philippines offers the Ph.D. program in agriculture, several areas in the natural sciences and the M.S. in engineering. The University of Santo Tomas has Ph.D. programs in the biological sciences, chemistry and pharmacy. The Ateneo de Manila University has a Ph.D. program in mathematics.

Preliminary enrollment data for 1975-76 show further increases in the number of students choosing the sciences and engineering. This can be seen from the following table.

Table III-8
Collegiate Enrollment in Universities and Colleges
By Field of Study, School Year 1975-76

Field of Study	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture*	26,373	22.3	12,783	2.0	39,156	5.1
Engineering & Trades*	18,619	15.7	97,242	15.0	115,861	15.2
Medical Sciences*	4,249	3.6	90,714	14.0	94,963	12.4
Natural Sciences	3,950	3.3	12,760	2.0	16,710	2.2
Education	23,330	19.7	44,832	6.9	68,162	8.9
Social Sciences	27,914	23.6	273,089	42.3	301,003	39.4
Humanities	3,832	3.2	77,710	12.0	81,542	10.7
Arts	1,023	0.9	12,700	2.0	13,723	1.8
Graduate Studies	9,160	7.7	24,445	3.8	33,605	4.4
Total	118,450	100.0	646,275	100.0	764,725	100.0

Source: Department of Education and Culture, Planning Service, Project Development and Evaluation Division.

Details may not add up to totals due to rounding.

*Available data did not show the breakdown of enrollment according to specific courses. It must be borne in mind, therefore, that as in Table III-7, totals for agriculture, engineering and trades, and the medical sciences include enrollment for both professional and subprofessional (i.e. associate degree, certificate, diploma, etc.) degree programs.

Trends in Graduates in the Sciences and Engineering

The total number of college graduates from all schools in the country more than doubled from 1959-60 to 1971-72. Among state colleges and universities, the increase during the twelve-year period was 133.6

per cent and among private universities and colleges, it was 144.2 per cent. As shown in Table III-9, there was a tremendous increase in the number of graduates from 1959-60 to 1971-72 (an overall growth of 280.6 per cent for all schools). From 1966-67 to 1971-72, however, the number of graduates declined by 36.2 per cent.[64]

Following the enrollment pattern, the number of graduates in the sciences and engineering from 1959-60 to 1971-72 has remained small. By broad fields of specialization, the total number of graduates in the agricultural sciences increased from 830 in 1959-60 to 1,111 in 1972. Most of these were from the state-supported schools. There was, however, a decline in the number of graduates from these schools in the period from 1959-60 to 1966-67. During this time, agriculture graduates from state colleges and universities decreased by 37.8 per cent. As a whole, the percentage share of these agriculture graduates (relative to the total in all fields in the state universities and colleges) decreased from 16 per cent in 1959-60 to 9.2 per cent in 1971-72. The majority of agriculture graduates finished the general curriculum leading to the B.S. in Agriculture: 416 in 1959-60 (89.5 per cent of all B.S. graduates), 418 in 1966-67 (86.5 per cent of B.S. graduates), and decreased to 384 in 1971-72 (making up only 38.5 per cent

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[64]A possible explanation for this decline is the student activism in the late 1960s and early 1970s. Student rallies and demonstrations often triggered civil disorder in the Metropolitan Manila Area and frequently resulted in the cancellation of classes (for several days or even weeks) by government authorities. Early in 1970, the peso was devalued, from an exchange rate of ₱3.90 to US$1 to a floating rate of ₱6.70-₱6.76. This caused a sharp increase in tuition fees in the private schools and the general cost of living. This also helps to explain the lower rate of increase in student enrollment from 1964-65 to 1971-72 (see Table III-7), and hence, further accounts for the decrease in graduates for 1971-72.

Table III-9*
College Graduates in Universities and Colleges
By Field of Study, School Years 1960, 1967 and 1972

Field of Study	1959-60					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	830	16.0	354	1.2	1,184	3.1
B.S. Degree	465	9.0	ND	-	-	-
Asso. Degree, Diploma, etc.[1]	352	6.8	ND	-	-	-
Veterinary Medicine	13	0.3	ND	-	-	-
Engineering and Technology[2]	346	6.7	3,037	9.1	3,383	8.7
B.S. Degree	213	4.1	ND	-	-	-
Asso. Degree, Technical, Vocational[1]	133	2.6	ND	-	-	-
Medical Sciences	204	3.9	3,529	10.5	3,733	9.6
B.S. Degree[3]	97	1.9	756	2.3	853	2.2
Dentistry (DDM)	10	0.2	380	1.1	390	1.0
Doctor of Medicine	97	1.9	999	3.0	1,096	2.8
Doctor of Optometry	-	-	197	0.6	197	0.5
Cert. of Midwifery, etc.[4]	-	-	1,197	3.6	1,197	3.1
Natural Sciences	183	3.5	222	0.7	405	1.0
Biological Sciences	166	3.2	ND	-	166	0.4
Mathematics, Physics and Statistics	-	-	ND	-	-	-
Chemistry	17	0.3	222	0.7	239	0.6
Geology	-	-	ND	-	-	-
Teacher Training/Education	1,873	36.1	8,406	25.1	10,279	26.6
Liberal Arts and Social Sc.	308	5.9	4,639	13.8	4,947	12.8
Law and Foreign Service	197	3.8	1,824	5.4	2,021	5.2
Music and Fine Arts	27	0.5	170	0.5	197	0.5
Commerce and Business Admin.	1,118	21.5	11,155	33.3	12,273	31.7
Graduate Studies[5]	106	2.0	160	0.5	266	0.7
Total, All Fields	5,192	100.0	33,496	100.0	38,688	100.0

Sources of Data: Department of Education, Board of National Education, School Statistics (mimeo.), 1960-61; 1967-68; 1972-73; Bureau of Private Schools, Private School Statistics (mimeo.), 1963-64.

Details may not add up to totals due to rounding. ND refers to no separate data.

[1]Requires less than four years to complete, education for technicians.

[2]Includes agricultural engineering.

[3]Includes the B.S. in Pharmacy, Industrial Pharmacy, Occupational Therapy, Physical Theraphy, Nursing, Medical Technology and Hygiene.

[4]Includes Nursing (R.N.)

[5]No breakdown by fields of study.

*Table is continued next page.

Table III-9*
College Graduates in Universities and Colleges
By Field of Study, School Years 1960, 1967 and 1972

Field of Study	1966-67					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	516	3.5	533	0.4	1,049	0.7
B.S. Degree	483	3.3	528	0.4	1,011	0.7
Asso. Degree, Diploma, etc.	33	0.2	5	Nil	38	Nil
Veterinary Medicine	-	-	-	-	-	-
Engineering and Technology	474	3.3	5,749	4.3	6,223	4.2
B.S. Degree	238	1.6	5,115	3.9	5,353	3.6
Asso. Degree, Technical, Vocational	236	1.6	634	0.5	870	0.6
Medical Sciences	211	1.4	6,098	4.6	6,309	4.3
B.S. Degree	31	0.2	2,491	1.9	2,522	1.7
Dentistry (DDM)	16	0.1	226	0.2	242	0.2
Doctor of Medicine	112	0.8	1,772	1.3	1,884	1.3
Doctor of Optometry	-	-	-	-	-	-
Cert. of Midwifery, etc.	52	0.4	1,609	1.2	1,661	1.1
Natural Sciences	246	1.7	1,843	1.4	2,089	1.4
Biological Sciences	217	1.5	1,143	0.9	1,360	0.9
Mathematics, Physics and Statistics	8	Nil	14	Nil	22	Nil
Chemistry	21	0.1	686	0.5	707	0.5
Geology	-	-	-	-	-	-
Teacher Training/Education	10,931	75.0	95,186	71.7	106,117	72.1
Liberal Arts and Social Sc.	333	2.3	6,533	4.9	6,866	4.7
Law and Foreign Service	134	0.9	1,493	1.1	1,627	1.1
Music and Fine Arts	42	0.3	198	0.1	240	0.2
Commerce and Business Admin.	1,341	9.2	14,693	11.1	16,034	10.9
Graduate Studies	343	2.4	365	0.3	708	0.5
Total, All Fields	14,571	100.0	132,691	100.0	147,262	100.0
Increase/(Decrease) Over Previous Total	9,379	180.6	99,195	296.1	108,574	280.6

*Table is continued next page.

Table III-9
College Graduates in Universities and Colleges
By Field of Study, School Years 1960, 1967 and 1972

Field of Study	1971-72					
	Public		Private		Total	
	Number	%	Number	%	Number	%
Agriculture	1,111	9.2	433	0.5	1,544	1.6
B.S. Degree	996	8.2	427	0.5	1,423	1.5
Asso. Degree, Diploma, etc.	86	0.7	-	-	86	0.1
Veterinary Medicine	29	0.2	6	Nil	35	Nil
Engineering and Technology	2,143	17.7	5,551	6.8	7,694	8.2
B.S. Degree	274	2.3	5,344	6.5	5,618	6.0
Asso. Degree, Technical, Vocational	1,869	15.4	207	0.3	2,076	2.2
Medical Sciences	189	1.6	5,031	6.2	5,220	5.6
B.S. Degree	27	0.2	2,112	2.6	2,139	2.3
Dentistry (DDM)	13	0.1	96	0.1	109	0.1
Doctor of Medicine	94	0.8	1,003	1.2	1,097	1.2
Doctor of Optometry	-	-	98	0.1	98	0.1
Cert. of Midwifery, etc.	55	0.5	1,722	2.1	1,777	1.9
Natural Sciences	162	1.3	1,976	2.4	2,138	2.3
Biological Sciences	47	0.4	1,612	2.0	1,659	1.8
Mathematics, Physics and Statistics	80	0.7	92	0.1	172	0.2
Chemistry	35	0.3	272	0.3	307	0.3
Geology	-	-	-	-	-	-
Teacher Training/Education	5,803	47.9	20,589	25.2	26,392	28.1
Liberal Arts and Social Sc.	610	5.0	11,534	14.1	12,144	12.9
Law and Foreign Service	97	0.8	1,550	1.9	1,647	1.8
Music and Fine Arts	42	0.3	591	0.7	633	0.6
Commerce and Business Admin.	1,221	10.1	34,067	41.6	35,288	37.6
Graduate Studies	753	6.2	477	0.6	1,230	1.3
Total, All Fields	12,131	100.0	81,799	100.0	93,930	100.0
Increase/(Decrease) Over Previous Total	(2,440)	(16.7)	(50,892)	(38.4)	(53,332)	(36.2)

of B.S. graduates for the year). The second biggest group of graduates within this field finished the B.S. in Forestry. In 1959-60 these numbered 39, increasing to 51 in 1966-67 and reached 113 in 1971-72. There were very few graduates in veterinary medicine: 13 in 1959-60 and 35 in 1971-72, and most (13 and 29 respectively) were from the University of the Philippines.

The number of engineering (B.S.) graduates from the state colleges and universities has been increasing but remains a very small percentage of graduates from all fields in these schools. The University of the Philippines contributed a large share of these engineering graduates: 132 in 1959-60 (62 per cent of the total from state-supported schools); 95 in 1966-67 (40.0 per cent of those from state universities and colleges); and 128 in 1971-72 (46.7 per cent of total from state schools).[65] According to specific engineering programs, most of the B.S. graduates from state colleges and universities were in agricultural, chemical, civil, mechanical and marine engineering. Most of the B.S. graduates from private schools were in mechanical, civil, chemical and electrical engineering. There were few graduates in agricultural engineering and most of them were from state colleges and universities, nearly all of them from the U.P. There were even fewer graduates in such courses as geodetic, mining and metallurgical engineering. In school year 1958-59, there were 14 areas of specialization in engineering and technology (including architecture) offered in private universities and colleges. In 1970-71, the number of these areas of specialization offered in private schools

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[65] Data on U.P. engineering graduates are from Luis D. Pascual, "Systems Approach to Engineering Education at the University of the Philippines System," Professorial Chair Lectures, Monograph No. 16 (Quezon City: University of the Philippines Press, 1976), Table I, pp. 7-8.

had increased to 29.[66]

Graduates in the medical and natural sciences from state universities and colleges have remained a very small percentage of total graduates in all fields. Moreover, graduates in the medical sciences from these schools have come exclusively from the U.P. (i.e. B.S. Pharmacy, Hygiene, Nursing, etc., M.D. and Dentistry) since it is the only school with complete degree programs in these courses. This also holds true for graduates in the natural sciences.

Among the private universities and colleges, the number of graduates in the medical sciences has been increasing over the years but decreasing as a proportion of total graduates from all fields. In 1959-60, graduates in this field numbered 3,529 and was 10.5 per cent of the total for all fields. This increased to 5,031 in 1971-72 but became only 5.6 per cent of the total for all fields. The number of graduates in the natural sciences has been increasing. It was 0.7 per cent of the total graduates for all fields in 1959-60 and reached 2.3 per cent in 1971-72. The number of graduates in physics, mathematics and statistics has remained few, being only 0.2 per cent (in 1971-72) of the total for all fields of study.

The bulk of college graduates in the country have been in the field of education/teacher training, reaching a peak of 75 per cent of total graduates in all fields in state colleges and universities in 1966-67. Among private universities and colleges, graduates in education for the same year was 71.7 per cent of the total. The trend has been reversed somewhat. Nevertheless, over half of all college graduates have degrees in education/teacher training and commerce/business administration.

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[66] Department of Education and Culture, Board of National Education, School Statistics, School Year 1971-72 (mimeo.)

Problems of Science Education and Training

Universities and colleges, both public and private, are confronted with several problems in producing the country's scientists, engineers and physicians. These arise primarily from their lack of financial resources which affect their administration and staffing, faculty development, facilities for research and ultimately their academic standards and quality of instruction.

Administration and Staffing in State Schools. The difference in the distribution of financial support to state universities and colleges lead to problems of administration and staffing among these institutions. The higher salary levels offered by the U.P. System and MSU attract the more qualified faculty to these schools. Since salary levels reflect the educational attainment of the faculty, it also means that these schools are better able to retain their highly qualified faculty members. Among the state colleges, Visayas State College of Agriculture (VISCA) has similarly been able to attract well qualified faculty members because of its higher salary scales. As a whole, state universities and colleges outside the Metropolitan Manila Area not only have difficulty attracting competent faculty, they also find it hard to retain those whom they are able to develop through their staff development programs. Thus the bulk of the faculty members of most of the state universities and colleges are bachelor's degree holders, some of whom have gained credit for some courses that they have taken for the master's degree. In a sample of 10 schools, the Presidential Study Committee on State Higher Education (PSC-SHE) in 1975 found that 71.6 per cent of their faculty are bachelor's degree holders and only .8 per cent have doctoral degrees. This is in contrast to that of the U.P. System where over half of its faculty members have graduate degrees.

The limited appropriations given to most schools means longer teaching hours for the faculty because of the lack of funds to increase their numbers. The PSC-SHE found that on the average, the faculty of these schools spend 20 hours a week teaching, with some having as much as 45 hours teaching assignment a week.[67] In most schools, teaching load exceeds 12 hours a week which is the maximum teaching load at the U.P. System. As a consequence, the faculty of these schools have little time left for research or professional development.

Facilities for Research. The limited funds available for these state colleges and universities have serious bearing on the availability of research facilities, i.e. library and laboratory equipment. This adversely affects the sciences and engineering since many, if not most books on the sciences, scientific journals and laboratory equipment have to be imported from outside the country. University/college administrators have had to explore possible sources of outside funding for these needs. This is also true with their faculty development programs. The University of the Philippines has been able to augment its resources for research by working for the creation of research centers attached to the University. Some of these are the Natural Science Research Center, Science Education Center, Philippine Eye Research Institute, Philippine Marine Sciences Center and others. Laws creating these

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[67] Presidential Study Committee on State Higher Education, *op. cit.*, p. 20.

centers for research have provided additional appropriations for the University in support of their research programs and activities.

In some cases, foreign aid has also been explored for these purposes. In the case of the Mindanao State University (MSU), for example, it was able to get a grant from the Ford Foundation in 1965 for $711,000 to develop its programs in the natural sciences for two years. Part of the amount was allocated for the purchase of laboratory science equipment.[68] It also received aid from the Government of New Zealand for the development of its dairy project -- acquisition of dairy animals, dairy equipment, tractor, farm equipment, and the like.

Faculty Development. Only a few schools have faculty development programs. Because of the lack of financial resources, these programs have also been very limited in scope. In the case of the U.P. System, it received considerable amount of external assistance for faculty development from the U.S. AID, the United Nations Development Programme, Rockefeller Foundation, Ford Foundation, Asia Foundation and others.[69] However, these resources have all been used up. MSU similarly had some assistance from the Ford Foundation for faculty development and from the East-West Center at the University of Hawaii. Nevertheless, for many state universities and colleges, faculty development depends heavily on

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[68] Mindanao State University, Fifth Annual Report, 1965-66, pp. 18, 25-26.

[69] External assistance to the U.P. from all sources (for buildings, equipment and books, fellowships abroad, visiting professors and others) from 1948 to 1968, totaled $45,061,000. Of these $12,658,000 (28.1 per cent) were for faculty fellowships abroad. See Case and Bunnell, op. cit., Table 4, pp. 25-28.

individual initiative and resourcefulness in looking for scholarship grants, both local and foreign. Local grants for graduate studies in the sciences and engineering are provided mainly by the National Science Development Board (NSDB) and the Philippine Council for Agriculture and Resources Research (PCARR) but again the slots are also limited.

The combined effect of these problems of low salaries, heavy teaching loads and limited opportunity for professional development among the faculty of most state universities and colleges is lower quality or standards of instruction and training for students in sciences and engineering. Moreover, opportunities of having research projects funded by the NSDB, PCARR or the National Research Council of the Philippines, which also means added income for the faculty and training opportunity for some students, are often lost. These funding agencies award research grants through open competition. Thus the bulk of NSDB funding for research, for example, eventually goes to the U.P. and the better staffed universities and colleges.

Quality of Graduates from Private Universities and Colleges. The standards of instruction among private universities and colleges tend to vary with the type and size of the school and to a certain extent, the availability of financial resources apart from the tuition fees collected by the school. Until 1972, very few of the private universities imposed any criteria of selective admission into their programs.[70] Those that

[70] The Presidential Commission to Survey Philippine Education in its survey found that only 42.3 per cent of private schools required entrance examinations in contrast to 90.3 per cent of public schools. For private schools, 92.8 per cent of the Catholic schools required entrance examinations compared to 19.0 per cent of the stock schools which had the same requirements. One fourth of the non-Catholic schools required them for entrance to certain college units only while nonstock schools did not require any. PCSPE, A Report on Higher Education in the Philippines, op. cit., p. 48 and Tables 1.1, 1.1.1, 1.1.2, Appendix "F".

used some criteria for admission were very often the sectarian, exclusive-type of schools. These are also the schools which have other sources of support apart from the tuition fees they collect from students. Hence, they can afford to have better laboratory equipment and other facilities as well as lower faculty/student ratios.

To ensure profits,universities and colleges organized as stock corporations or single proprietorships encourage large enrollments. Some have 30,000 or even more students. Hence, standards are often watered down by the very large classes, long teaching hours for the faculty and limited laboratory facilities. The normal teaching load for many full-time faculty members of these schools is 18 to 24 hours a week (six to eight classes). The mixture of mostly mediocre students with a few bright ones in the classrooms means that the standards of instruction have to be adjusted to the level of the greater number of students. The obligation to declare yearly dividends to stockholders forces these schools to economize in their operations and this often results in sacrificing the improvement of the physical plant and foregoing the acquisition of expensive laboratory equipment. Similarly, in private schools where the original capital investments are loans from financing institutions, standards are sacrificed to enable the school to meet regularly its financial obligation.[71]

There are, in addition, differences in standards between private universities and colleges in Metropolitan Manila and those outside it, as well as between those in other large urban centers and those in the provincial, rural areas. In many private schools in the latter, there is a

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[71]Narciso Albarracin, "State of Private Higher Education," FAPE Review, Vol. 6, No. 1 (July 1975), p. 8.

dearth of qualified instructors, professors and school administrators. A majority of these have bachelor's degrees. In Metropolitan Manila, the private universities and colleges have generally better qualified faculty. Nevertheless, the situation is aggravated by the fact that many college personnel are part-time teachers.[72]

Some private schools tend to develop specialization in one or two fields where their graduates would be well prepared to top the professional board examinations. This becomes an effective advertisement for the school regarding the quality of its instruction. This is because the results of these examinations are widely publicized in the national newspapers with the names of the first ten ranking successful examinees and the schools from which they obtained their degrees. In many cases, however, the percentage of graduates of each school passing these examinations reveal a very large proportion of failures and can be used as an index of their low standards of instruction. Graduates of the University of the Philippines seldom get the top places of these board examinations but on the average, few of its graduates fail in these examinations. There is thus a large amount of wastage among the graduates of private universities and colleges. Table III-10 gives an idea of the general quality of instruction in universities and colleges in the Philippines.

Government Reforms for Quality Education

The government has become more cognizant of the important role played by private universities and colleges in the country. It has enacted several laws designed to assist these schools to improve their standards

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[72] Ibid.

Table III-10
Performance of Candidates Taking the Professional Board Examinations as an Index of the Quality of Graduates in Universities and Colleges, 1971-1973

Title of Professional Board Examination	Percentage of Candidates Passing Examination in Selected Years			
	1971	1972	1973	Average
Accountancy	15%	10%	19%	15%
Law	42	37	45	41
Mechanical Engineering	34	31	38	34
Civil Engineering	42	40	45	42
Mining Engineering	45	47	44	45
Electrical Engineering	78	82	74	78
Chemical Engineering	30	44	63	46
Chemist	77	60	28	55
Dietitians	74	48	62	61
Dentist	53	43	33	43
Medical Technologist	47	40	48	45
Pharmacy	53	53	62	56
Medicine*	87	n.d.	81	n.d.

Sources of Data: Narciso Albarracin, "State of Private Higher Education," FAPE Review, Vol. 6, No. 1 (July 1975), p. 9; Journal of Philippine Statistics, Vol. 22, No. 4 (Fourth Quarter 1971), p. 31 and Vol. 26, No. 3 (Third Quarter 1975), p. 25.

*Data for Medicine are for 1969-70 and 1974 only.

of instruction. In June 1964, the President signed into law, Republic Act No. 4056 which set aside funds to improve medical education by providing financial assistance to private medical schools. Under this law such financial assistance will be certified by the Board of Medical Education on two conditions: that such a school maintains standards of medical education acceptable to the Board and that it maintains at least one hundred hospital beds and corresponding facilities for the care of the medically indigent population of the country. The funds would be partly taken from the proceeds of at least one sweepstakes draw each year.[73]

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[73] Republic Act No. 4056, Secs. 1, 3.

On 5 November 1968, the President signed Executive Order No. 156 creating the Fund for Assistance to Private Education (FAPE).[74] The FAPE was the result of the establishment of a ₱24 million irrevocable trust fund for education by the Philippine and United States governments. It aims to develop academic excellence in private education, wherein graduates would be "assimilated into a changing and dynamic society in a way that they would be able to contribute and play meaningful roles in the country's pursuit of modernization, economic growth and development."[75] The Fund has been used to finance faculty development of private universities/colleges through scholarship grants for the completion of master's or doctoral programs in the Philippines. As of school year 1971-72, a total of 207 private school faculty members had been benefited by the FAPE's scholarship program. The FAPE also finances symposia, seminars and conferences for private school faculty and administrators. Through a system of grants-in-aid, it supports special programs of study in selected schools especially those involving the improvement of teaching science. An example of this is the Master of Science in Teaching (MST) program of Ateneo de Manila University where FAPE has provided funding for 20 scholarships for an MST degree in physics and another 20 for an MST in chemistry as well as an amount for the purchase of necessary equipment for the programs.[76]

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[74] "FAPE Marks 4th Year," FAPE Review, Vol. 3, No. 2 (March 1973), p. H; "Moving Private Education Forward," Philippine Development, Vol. V, No. 11 (31 October 1977), pp. 11-12.

[75] PCSPE, A Report on Higher Education in the Philippines, op. cit., p. 42.

[76] "Renewed Support," FAPE Review, Vol. 2, No. 2 (September 1971), pp. C and H.

In 1969, the President created a Presidential Commission to Survey Philippine Education (PCSPE) to "analyze the performance of the educational system and its relevance to development goals" with emphasis on the "system's capacity to attain goals in human resources development including meeting manpower requirements of national development," and to recommend ways of improving Philippine education.[77] The Commission reported:

> For higher education, there is an oversupply of a sizable number of college-trained manpower. This fact should encourage bold recommendations that would result in cutting down college enrollment, especially those involving raising quality through accreditation of schools, selective admission and collection and dissemination of information on the labor education market since there will be no danger of incurring a shortage.[78]

The government since 1972 has tried to implement some of the recommendations of the PCSPE. It promulgated a Presidential Decree "Authorizing the Undertaking of Educational Development Projects" designed to rationalize the educational system in the country.[79] It aims at the improvement of curricular programs and quality of instruction of all levels of the school system by upgrading physical facilities, training and retraining of teachers and administrators, the upgrading of academic standards through accreditation, admissions, testing and guidance counselling. The decree calls for a restructuring of higher education to make it more responsive to "national development needs through a planned system of incentives and assistance to both public and private colleges and universities." It

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[77] Executive Order No. 202, series 1969.

[78] PCSPE, <u>Education for National Development: New Patterns, New Directions</u>, <u>op</u>. <u>cit</u>., p. 40.

[79] Presidential Decree No. 6-A, 29 September 1972, as amended by Presidential Decree No. 365, 3 January 1974.

also provides for a scheme of funding these undertakings and creates the Educational Development Projects Implementing Task Force (EDPITAF) within the Office of the Secretary of Education and Culture to supervise and implement foreign-assisted development projects.

To help improve standards of higher education, a decree was issued requiring all students to pass the National College Entrance Examinations (NCEE) before admission to post secondary courses which require at least four years to complete. This became effective in school year 1974-75.[80] The policy of the Department of Education and Culture is to work for the gradual reduction of enrollment at the college level using the NCEE, i.e. setting up cut-off scores in the entrance examinations which students must pass, until the optimum size of enrollment is reached. For example, it can tie this up with a target of only 15,000 students who should be admitted to enroll thus regulating as well the supply of college graduates. While the DEC has not set up any quotas for enrollment, it has urged private school entrepreneurs to accept the pressing need to "put a stop to a glaring educational fraud which has been perpetrated since Liberation."[81]

A more recent form of assistance extended by the government to private schools is the improvement of engineering programs in selected universities and colleges. Administered by the Educational Development Projects Implementing Task Force (EDPITAF), the government seeks to upgrade engineering education through the extension of soft, long-term loans to deserving schools offering undergraduate degrees in civil, mechanical,

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[80]Presidential Decree No. 146, 9 March 1973.

[81]Albarracin, <u>op</u>. <u>cit</u>., p. 9.

chemical and electrical engineering. The loan would be used for laboratory and supportive facilities and equipment, training of teachers and administrators. Twenty schools have been chosen by EDPITAF from a survey of 100 engineering schools all over the country to participate in this project. These schools are to help initiate and carry out reforms in engineering education. Ten of these are chosen as Resource Base Schools for their strategic location all over the country to assume the responsibility of planning, developing and disseminating reform programs in their respective regions. Under this project, the U.P. College of Engineering will set up a Master of Engineering Education Program where faculty members of participating schools can be sent for further education. A National Engineering Center within the U.P. System will be established to undertake, sponsor and coordinate programs of staff training, curricular development and the design and distribution of improved teaching equipment and materials.[82] An important consequence of the project is the creation of a seven-member Technical Panel for Engineering Education. The Technical Panel is vested with the responsibility of studying and recommending strategies "to rationalize and make more effective the existing and proposed engineering education institutions as regards their programs, facilities, personnel, organization, operation, funding and output standards."[83] The Panel will operate and serve as a staff or consultative and advisory body to the Bureau of Higher Education. The Panel will also develop an accreditation

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[82]Educational Projects Implementing Task Force, "Engineering Education Project," Summary, (1976, mimeo.), pp. 2-3.

[83]Department of Education and Culture, Department Order, 1977, "Creating the Technical Panel for Engineering Education and Defining its Functions and Responsibilities," (mimeo.), p. 2.

system in order to evaluate the performance of engineering schools. This will serve as the basis for the granting by the Secretary of the Department of Education and Culture of the authority to establish and/or to continue offering specific engineering courses. The state-supported colleges of engineering will also be evaluated for the purpose of accreditation.

Role of Industry in the Education and Training of Scientists and Engineers

Industry has generally contributed to the education and training of scientists and engineers in the Philippines in two ways: by providing in-service training for the graduates that they employ and through their financial support to universities and colleges in the form of scholarships, professorial chairs and funds for scientific research projects. Such financial contribution may be made directly by private firms to educational institutions of their choice. They usually choose schools which have already established reputably high standards of instruction in the sciences and engineering. For example, pharmaceutical firms generally donate scholarship grants and awards to outstanding graduates of medical schools.[84] Other industries tend to donate scholarships for engineering

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[84] This can be seen, for instance, in the Bulletin of Information, 1975 of Manila Central University's Filemon D. Tanchoco Medical Foundation and the Bulletin of Information, 1976-77 of the Cebu Institute Medicine. Both list one year scholarships for medical students donated by Winthrop Stearns, Inc. and Lederle Philippines, Inc. At the MCU-FDT Medical Foundation, there is also an advertised award for an outstanding graduate by A.H. Robins, another pharmaceutical firm.

and the applied sciences.[85] In addition, pharmaceutical firms actively support continuing education seminars, conferences, symposia and other postgraduate programs conducted by the various medical associations and the allied health professional organizations.[86]

Some private companies also grant research funds for certain projects in universities and colleges. Often this would be related to experiments testing some of their products. This can be seen, for example, in research projects on the effect of certain chemical fertilizers on crop yields undertaken by some of the agricultural colleges. Sometimes such donations are in support of research on environmental pollution. For example, three companies have donated funds to support the Cebu Harbor Pollution research project of the University of San Carlos.[87]

Private firms, moreover, contribute to the education and training of scientists and engineers by setting up their own science research

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[85] At the University of the Philippines, College of Engineering, during school year 1976-77, there were three scholarships donated by Asia Industries, Inc., one by Air Mac Philippines, Inc., four by Petrophil Corporation, one by Marcelo Industrial Corporation and three by Cyanamid Philippines, Inc. The last two donors specified that the scholarship grants are for students in mining or metallurgical engineering. At the University of the Philippines at Los Baños, during school year 1973-74, Bayer Philippines, Inc., Hoechst Philippines, Inc. and Pfizer Philippines, Inc., donated one man-year undergraduate scholarships each in plant pathology and animal science. See University of the Philippines, College of Engineering Catalogue, 1976-77, pp. 26-29; Office of Student Affairs, U.P. at Los Baños, unpublished data on scholarships donated to the university.

[86] For example, United Laboratories in 1976 helped to finance the conventions of the Philippine Pediatric Society, Philippine Medical Association and Philippine Medical Women's Association. "Unilab Assists PPS Realize its objectives," Bulletin Today, 3 May 1976, p. 29; "United Lab Support PMWA Projects," Bulletin Today, 23 April 1976, pp. 27, 28.

[87] Interview with the Vice President for Finance, San Carlos University, Cebu City, 27 April 1977.

foundation[88] or donating money and equipment to such foundations established by universities/colleges, other private institutions or individuals. The establishment of private science foundations has been encouraged by the government under the Science Act of 1958 (Republic Act 2067, as amended) which created the National Science Development Board. These foundations are nonstock and nonprofit organizations which are required by law to spend at least 51 per cent of their gross income to support scientific research, grant scholarships and create professorial chairs in the medical, natural and social sciences and engineering. They are certified by the NSDB Committee on Science Foundation. A member of this Committee represents the NSDB in the Board of Directors of each foundation. NSDB certification of these private foundations entitles donors to tax exemptions for their contributions. This certification is given by the NSDB for a period of five years and renewable provided they comply with its regulations.[89] As of 1977, the NSDB had certified 137 foundations, 36 of which were set up specifically for the purpose of supporting basic and applied research, scholarships and professorial chairs in agriculture,

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[88]For example, Ayala Corporation, the country's oldest and one of the largest corporations, set aside ₱13 million to support the Filipinas Foundation in 1963. The Foundation funds researches in agriculture and industry undertaken by universities/colleges as well as individual scientists and grants scholarships. See Ninotcka Rosca, "The Oldest Corporation in the Philippines," The Fookien Times Yearbook, 1975, p. 162. San Miguel Corporation similarly set up the San Miguel Foundation. This Foundation donates scholarships, professorial chairs and research funds in the sciences and engineering. In 1976, it donated a professorial chair for engineering at the University of San Carlos. See University of San Carlos, Information Bulletin, 1976.

[89]NSDB, Regulations No. 1, "Rules and Regulations to Implement Section 24 of Republic Act No. 2067 as Amended by Republic Act No. 3589," (Revised 25 November 1969, mimeo.).

medicine, the natural sciences and engineering.[90]

Summary and Conclusion

The data presented in this chapter shows that there has been a tremendous expansion in higher education in the Philippines since 1946. This is evidenced by the rapid growth in both the number of state-supported and private universities and colleges and the number of their graduates.

There has been no national plan for the growth of these institutions. The creation of state-supported colleges and universities has been largely the result of political rather than rational considerations. Social demand for higher education has greatly influenced the expansion of private universities and colleges. Academic standards in these private institutions have varied as many are operated for profit. As science and engineering degree programs are expensive to maintain, few private universities have been encouraged to expand into these fields. Of the few private institutions that have gone into these programs, most have had to seek external financial assistance in order to provide quality education in the sciences and engineering.

Students have generally enrolled in courses which they perceive to have relatively better employment opportunities and which their families could afford to pay for. As science and engineering degrees are expensive in terms of tuition fees, books, etc. and also take longer to complete, only the middle- and higher-income families can support such studies. Among the established science professions, medicine and engineering have attracted relatively larger enrollments. There has thus been an overpro-

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[90]The rest of the foundations were created to support research in the social sciences, community development projects, and others. Unpublished information from the NSDB Committee on Science Foundation.

duction of graduates in teacher training/education and commerce/business administration courses and very little in the fields of agriculture and the natural sciences.

The lack of a national education plan which would be related to national development plans has, therefore, led to a lopsided production of college graduates in the Philippines. The country's universities and colleges have produced relatively few scientists particularly in such fields as biological sciences, physics, mathematics, statistics and geology. In the discussion on the brain drain in Chapter II, it appeared that the number of natural scientists emigrating to the United States and other countries was relatively small. Seen in the context of the data presented in this chapter, it seems that this number is relatively large. Considering the variations in the quality of education and training provided by the universities and colleges in the Philippines and the selective nature of educational qualifications required for immigration to the United States, Canada and other countries, this also means that the Philippines has been losing its better-trained scientists and engineers. If this is so, then there is indeed cause for serious concern. This is because the country needs them to propel and sustain its development.

In the field of science education, the small number of science and engineering graduates and the loss of a large proportion of these to other countries further hampers the work of improving the quality of the educational system and advancing scientific research on Philippine problems. Many of these emigrant scientists and engineers initially go abroad precisely to have further education and training in their fields since there is little opportunity and limited facilities for such studies within the country. Their decision not to return to the country defeats the purpose of their advanced training when viewed against the development goals and needs of Philippine society. The highly qualified scientists who remain become overburdened with the demands of teaching, extension work and research. Consequently, many find it difficult to keep abreast of developments in their own fields. The building of science in the Philippines thus becomes impaired further.

The government has introduced several reforms and policies to rationalize and upgrade higher education in the Philippines since the latter part of the 1960s. The effects of these are only beginning to be felt and some have already been discussed in this chapter. In the next chapter, we will look at the development of professional organizations of scientists and engineers in the country, the role they play in the education and training of their members as well as in policy-making for education and scientific research.

Chapter IV

Professional Organization of Scientists and Engineers

The rise of professional organizations of scientists and engineers in the Philippines closely parallels the development of professional education in the country's university system. As we saw in the last chapter, the earliest professional education in science, which became available at the University of Santo Tomas during the Spanish regime, was in the field of medicine, pharmacy and related disciplines. At that time, the conferment of the appropriate degree or diploma by the University was equivalent to the achievement of professional status and gave the graduates license to practice their profession.

The arrival of the Americans and the introduction of new educational policies and the expanded functions of government during their regime gave an impetus to the growth of professional education. Courses for the education and training of nurses, dentists, engineers, architects, natural scientists, veterinarians, agricultural scientists and other professionals became available for Filipinos at the state-supported University of the Philippines, the University of Santo Tomas and other private colleges that were subsequently opened. In addition, the government began to enact legislation which provided for the licensing and regulation of the professions. Professional status was eventually accorded only to individuals who not only possessed the requisite educational qualifications but also passed the licensing examinations. Only then was an individual registered as a member of his profession. The number of professional scientists and engineers grew over the years. This paved the way for the establishment of professional organizations or associations. This chapter will examine how these professional societies originated and how they have influenced policies for the licensing and regulation of their professional practice.

Origins of Professional Associations

The earliest scientific professional associations in the Philippines were organized in the field of pharmacy and medicine. On 3 January 1892, a group of pharmacists in Manila set up the Colegio Farmaceutico de Filipinas for the promotion and protection of their professional interests. The organization published the Revista Farmaceutica de Filipinas containing results of investigations and studies made by the local scientists.[1] Some years later, on 8 June 1899, a group of physicians and pharmacists organized the Colegio Medico-Farmaceutico de Filipinas to work for the advancement of science in the country and the promotion of their professional welfare and interests. The Colegio represented the Spanish-European traditions of medical and pharmaceutical education and training. It had a monthly publication, the Revista Filipina de Medicina Y Farmacia.

The Colegio Medico-Farmaceutico's founding was soon followed by the establishment of a rival organization, the Manila Medical Society on 9 July 1902 by a group of American and Filipino physicians.[2] The Society, which represented the more recent American tradition of medical education in the country, published its own Bulletin. It immediately applied for affiliate membership in the American Medical Association (AMA). The Society was, however, informed that a single city chapter could not qualify for affiliation and that a national society would have to be organized first before

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[1]Leoncio Lopez Rizal, "Scientific and Technical Organizations in the Philippine Islands," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 3 (Manila: February 1935), p. 160.

[2]The first president of the Society was an American, Dr. John R. McDill. "Manila Medical Society," editorial, Bulletin Today, 9 July 1977, p. 6.

their application would be granted. This was a requirement laid down by the Constitution of the AMA. So the members of the Manila Medical Society founded the Philippine Islands Medical Association on 15 September 1903.[3] It became the dominant medical association of the country, overshadowing the Colegio Medico-Farmaceutico in medical politics. The Colegio's members eventually joined the Manila Medical Society, and the Colegio assumed a submissive role within the Society and the national Association. In the 1930s, the Philippine Islands Medical Association adopted its present name -- the Philippine Medical Association (PMA).

The PMA became a component member of the American Medical Association. Its first constitution was closely patterned on that used by comparable units of the AMA in the United States. The PMA's first president, secretary-treasurer and all five councillors were Americans and the American medical code of ethics became applicable for Filipino physicians without modification.[4] American influence was thus pervasive in the early years of the PMA's existence. By the early 1920s, however, all the offices in the Association were held by Filipinos.

The PMA's leadership and most of its members came at first from the government's educational and health units -- the University of the Philippines College of Medicine, the Philippine General Hospital, the Bureau of Health, and the Bureau of Science. This close link between the PMA and government medicine began to be questioned by a number of private practitioners in the 1920s and 1930s. Unable to gain control of the Association, they formed a rival organization in 1932 known as the Federation of Private

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[3] Antonio S. Fernando, M.D., "The Philippine Medical Association," Journal of the Philippine Medical Association, Vol. XXIX, No. 5 (May 1953), p.233.

[4] Robert Stauffer, The Development of an Interest Group: The Philippine Medical Association (Quezon City: University of the Philippines Press, 1966), p.21.

Medical Practitioners. Members of the Federation could simultaneously belong to the PMA but "the militancy of the former during this era suggests that few did belong and fewer still in any active sense."[5]

The PMA's close relationship with the government during this time enabled it to establish branches in the provinces, especially in cities where government hospitals had been set up. The Association, however, remained Manila-centered in terms of leadership and activities. From 1931 to 1941, out of a total of 44 individuals elected to the top offices of the PMA, only four came from outside Manila and only one succeeded in becoming the Association's president. The PMA's power was not only centered in Manila, it was also dominated by government physicians, most of whom taught at the U.P. College of Medicine or worked at its affiliated hospital -- the Philippine General Hospital. As one writer described it, power within the PMA was also concentrated in a tight oligarchy.

> There was no active campaigning for office in the Association, no open debate on fundamental policies. Rather, the style was one of a dignified, scholarly approach to the problems of the medical profession, the publication of a serious journal given over to research articles, and an annual convention at which behind-the-scenes decisions on policies and leaders for the next year were ratified.[6]

At the outbreak of World War II, the Association's membership had reached 1,167. The PMA suspended its formal activities during the War to prevent the Japanese from using the Association for propaganda purposes.

The increase in the number of higher educational institutions and the introduction of government licensing and regulation of the professions gave

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[5] Ibid., p. 22.

[6] Ibid.

impetus to the organization of other scientific professional societies in the country. The history of the Philippine Dental Association follows a similar pattern to that of the Philippine Medical Association. It was originally made up of two rival organizations representing two different traditions of the dental profession in the country. The Sociedad Dental de Filipinas was the first dental association founded in the country in 1908.[7] The Sociedad's professed aim was to work for the improvement of the dental profession through reforms and the establishment of regular dental schools. It published its own organ, the Odontologia Filipina.

The National Dental Association (NDA) was organized in 1924 by the younger dentists, many of whom had finished their studies in the United States. It had its own publication, the National Dental Review. The NDA became active in organizing the profession through the establishment of local chapters. The Manila Dental Society, for example, was organized on 12 June 1936 by thirty-two Association members.[8]

Other professional associations in the health and medical sciences that were organized before World War II were the Philippine Veterinary Medical Association in 1907, the Philippine Pharmaceutical Association in 1920, the Philippine Nursing Association in 1922 and the Philippine College of Surgeons in 1936.

In the physical sciences and engineering, professional societies were organized as early as 1920. In that year, the Philippine Institute of Engineers and Architects was founded. This organization split in 1933 to form two

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[7] Philippine Dental Association, "Brief History of the Philippine Dental Association," Bulletin Today, 8 May 1977, p. 8.

[8] "Manila Dental Society Holds 40th Annual Convention," Bulletin Today, 3 September 1976, p. 35.

separate professional groups -- The Philippine Society of Civil Engineers and the Philippine Institute of Architects.[9] The other engineering societies that were established before 1946 were the Philippine Association of Mechanical and Electrical Engineers (1930), the Philippine Association of Civil Engineers (1937), the Philippine Institute of Chemical Engineers (1939) and the Philippine Society of Mining, Metallurgical and Geological Engineers (1940). The practicing chemists organized the Chemical Society of the Philippines in 1937.

Professional societies helped to promote a sense of community among their members as well as provide for continuing education in the profession. Regular meetings or conventions became occasions for the presentation of scientific and technical papers. Professional journals, bulletins or newsletters provided channels for the exchange of information on developments in their respective fields of interest. The societies were also instrumental in upgrading the standards of professional education and in the enforcement of government regulations affecting their specializations.

The professional societies discussed above were based on specific disciplines, but other types of professional associations began developing also. Some were interdisciplinary in orientation such as, for example, the Philippine Scientific Society and the Los Baños Biological Club which were both organized in 1923, the Philippine Society for the Advancement of Research and the Philippine Society of Parasitologists which were founded in 1930. In addition, there were professional organizations of a more functional nature such as the Philippine Islands Antituberculosis Society organized in 1910, the International Leprosy Association founded in 1931, the Philippine Public Health Association set up in 1932 and the Philippine

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[9] Rizal, _op. cit._, p. 179.

League Against Cancer founded in 1934.[10] It was not unusual for scientists of that time to be simultaneously members of several of these societies and professional associations.[11]

Early Government Licensing and Regulation

Just as the earliest scientific professional education in the Philippines was established in the field of medicine, the first government regulations regarding professional licensing and practice were also for practitioners of medicine and surgery. On 4 December 1901, the Philippine Commission passed an Act regulating the practice of medicine and surgery in the country. The legislation created a Board of Medical Examiners whose members were to be appointed by the Commissioner of Public Health from physicians in good standing. It provided, moreover, that physicians appointed to the Board should not be connected in any way with, or have any pecuniary interest in, any of the medical schools. The Board, which was attached to the Department of the Interior, was charged with the responsibility of administering examinations to graduates of medical schools and colleges and issuing certificates of registration to successful examinees. These certificates were proof of their license to practice the profession. The Board was also entrusted the duty of licensing midwives in accordance with the procedure laid down by the law.

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[10] Ibid., pp. 176-181.

[11] This can be seen, for example, in the brief biographical accounts of the 114 chartered members and 250 associate members of the National Research Council of the Philippine Islands in 1934-35 which was published in its Annual Report, 1934-35, Bulletin No. 7 (Manila: February 1935).

Dentistry was the next profession to be subjected to similar licensing and regulatory laws. On 10 January 1903, the Philippine Commission passed an Act creating a Board of Dental Examiners to administer examinations to graduates of dental schools.[12] The Board was also charged with the responsibility of issuing certificates of registration to those who qualified for professional practice. In the same year, another Act created a Board of Examiners for Pharmacists. By 1920, similar laws granting professional status and regulating practice had been passed for graduates of optometry, civil, mechanical, electrical, mining and chemical engineering, as well as for architecture and accountancy. The organization of the boards of examiners for these professions were patterned after that of the Board for the examination of physicians.

Growth of Professional Scientific and Engineering Societies After Independence

The number of professional associations in science and engineering has greatly increased since the Philippines gained independence in 1946. Several factors have contributed to this situation. One has been the increasing specialization in education and training for the professions. As the number of specialists in a profession increased, they organized their own societies or associations to promote their interests and to enforce standards of professional practice. In many cases, these groups have worked together for the enactment of laws creating licensing and regulatory boards and these boards have become the hallmark of professional status.

The field of engineering, perhaps, shows how specialized associations

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[12] Domiciano J. Sandoval, "Historical Development of Dentistry Through Legislation," National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 4 (February 1935), pp. 349-353.

have increased and thus expanded the engineering profession. While there were only five branches of engineering, i.e. civil, mechanical, electrical, mining, and chemical engineering, and architecture, represented by professional societies and regulated by boards of examiners before the Second World War, there are now eleven such fields. Those that have been added since 1946 are sanitary, geodetic, agricultural, electronics and communications engineering, and naval architecture and marine engineering. Table IV-1 shows the growth of the number of registered professional engineers in different areas of specialization.

In the field of the medical and health sciences, there are now ten occupations which have separate examining and licensing boards compared to only six before independence.[13] The recent additions are dietetics, physical and occupational therapy, medical technology and midwifery. Other fields which have established licensing boards are chemistry, forestry, geology and sugar technology. As one who has studied some professions in the Philippines put it:

> The propensity to create professions is one indicator of the charge that Filipinos tend to be "over-educated" and "over-qualified" and may be an extension of the diploma syndrome. Every occupational group wants to limit entrance, a desire that can be affected by increasing the qualifications of practitioners and raising the requirements for practice.[14]

Table IV-2 shows the growth of the number of registered professionals in the medical, health and other sciences.

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[13]The six were medicine, dentistry, pharmacy, veterinary medicine, nursing and optometry.

[14]Ledivina V. Cariño, The Role of the Professions in National Development (Manila: University of the Philippines, College of Public Administration, 1973 , mimeo.), p. 8.

Table IV-1*
Cumulative Number of Registered Architects and Engineers
Selected Years, from 1950 to 1975

Field of Specialization	1950	1955		1960	
	Number	Number	% Increase	Number	% Increase
1. Architects	404	899	122.5	1,351	50.3
2. Professional Electrical Engineers	142	181	27.5	270	49.2
3. Associate Electrical Engineers	217	248	14.3	362	46.0
4. Assistant Electrical Engineers	59	419	610.2	784	87.1
5. Professional Mechanical Engineers	256	411	60.5	692	68.4
6. Mechanical Plant Engineers[1]	961	1,139	18.5	1,500	31.7
7. Junior Mechanical Engineers[1]	225	2,010	793.3	3,436	70.9
8. Mechanical Engineers	-	-	-	-	-
9. Chemical Engineers	164	572	248.8	1,288	125.2
10. Mining Engineers	295	364	23.4	465	27.7
11. Naval Architects/ Marine Engineers[2]	-	-	-	-	-
12. Agricultural Engineers[3]	-	-	-	-	-
13. Geodetic Engineers[4]	-	-	-	-	-
14. Sanitary Engineers[5]	-	-	-	111	-
15. Civil Engineers	2,405	4,246	76.5	6,029	42.0
Total	5,128	10,489	104.5	16,288	55.3

Source of Data: Republic of the Philippines, National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 570-572.

[1]Registration was discontinued when Mechanical Engineers' registry was initiated in 1968 as a result of Republic Act No. 5336 (15 June 1968). Mechanical Engineers have at least a Bachelor's degree in mechanical engineering and have passed the Board Examinations for Mechanical Engineers. Professional Mechanical Engineers need four more years of active practice as mechanical engineers and must pass the Board Examinations for Professional Mechanical Engineers.

[2]Registration of Naval Architects and Marine Engineers began in 1965 as a result of Republic Act No. 4565 (19 June 1965).

[3]Registration of Agricultural Engineers began in 1965 as a result of Republic Act No. 3927 (18 June 1964).

*Table is continued next page.

Table IV-1 (continued)
Cumulative Number of Registered Architects and Engineers
Selected Years, from 1950 to 1975

Field of Specialization	1965		1970		1975	
	Number	% Increase	Number	% Increase	Number	% Increase
1. Architects	2,116	56.6	3,121	47.5	4,704	50.7
2. Professional Electrical Engineers	495	83.3	652	31.7	1,000	53.4
3. Associate Electrical Engineers	524	44.8	674	28.6	1,166	73.0
4. Assistant Electrical Engineers	1,487	89.7	2,380	60.0	4,425	85.9
5. Professional Mechanical Engineers	1,247	80.2	1,512	21.3	1,682	11.2
6. Mechanical Plant Engineers	1,943	29.5	2,070	6.5	-	-
7. Junior Mechanical Engineers	5,445	58.5	6,887	26.5	-	-
8. Mechanical Engineers	-	-	2,339	-	10,158	334.3
9. Chemical Engineers	2,511	95.0	4,886	94.6	7,390	51.2
10. Mining Engineers	660	41.9	926	40.3	1,167	26.0
11. Naval Architects/ Marine Engineers	3	-	88	2,833.3	126	43.2
12. Agricultural Engineers	137	-	304	121.9	542	78.3
13. Geodetic Engineers	847	-	3,170	274.3	3,221	1.6
14. Sanitary Engineers	250	125.2	347	38.8	490	41.2
15. Civil Engineers	7,750	28.5	10,941	41.2	15,507	41.7
Total	25,415	56.0	40,297	58.6	51,578	28.0

[4]Registration of Geodetic Engineers began in 1965 as a result of Republic Act No. 4374 (19 June 1965).

[5]Registration of Sanitary Engineers began in 1956 as a result of Republic Act No. 1364 (18 June 1955).

Table IV-2*
Cumulative Number of Registered Professionals in the Medical, Health and Other Sciences
Selected Years, from 1950 to 1975

Registered Professionals	1950	1955		1960	
	Number	Number	% Increase	Number	% Increase
Dentists	3,751	7,141	90.4	8,513	19.2
Physicians	7,845	10,704	36.4	16,650	55.5
Nurses	7,268	10,267	41.3	15,776	53.7
Pharmacists	5,755	10,463	81.8	14,434	38.0
Midwives	2,511	3,679	46.5	8,162	121.9
Dieticians[1]	-	-	-	-	-
Optometrists	456	620	36.0	1,210	95.2
Veterinarians[2]	-	342	-	412	20.5
Chemists[3]	-	535	-	1,292	141.5
Geologists[4]	-	-	-	-	-
Total	27,586	43,751	58.6	66,449	51.9

Source of Data: Republic of the Philippines, National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 572-573.

[1]Registration of Dieticians started in 1962 as a result of Republic Act No. 1674 (18 June 1960).

[2]Postwar registration of Veterinarians was revised and started in 1951 as a result of Republic Act No. 382 (18 June 1949).

[3]Registration of Chemists became effective in 1953 with the enactment of Republic Act No. 754 (18 June 1952).

[4]Registration of Geologists became effective in 1965 with the approval of Republic Act No. 4209 (19 June 1965).

*Table is continued next page.

Table IV-2 (continued)
Cumulative Number of Registered Professionals in the Medical, Health and Other Sciences
Selected Years, from 1950 to 1975

Registered Professionals	1965		1970		1975	
	Number	% Increase	Number	% Increase	Number	% Increase
Dentists	11,046	29.8	12,174	10.2	13,096	7.6
Physicians	23,921	43.7	30,718	28.4	37,276	21.3
Nurses	24,836	57.4	38,911	56.7	64,155	64.9
Pharmacists	17,405	20.6	19,073	9.6	20,838	9.3
Midwives	13,113	60.7	16,164	23.3	26,686	65.1
Dieticians	291	-	940	223.0	1,244	32.3
Optometrists	2,088	72.6	2,676	28.2	3,195	19.4
Veterinarians	498	20.9	727	46.0	971	33.6
Chemists	2,327	80.1	3,424	47.1	4,324	26.3
Geologists	3	-	332	10,966.7	429	29.2
Total	95,528	43.8	125,139	31.0	172,214	37.6

Another factor that has contributed to the proliferation of professional societies in the Philippines has been the presence of factions in these organizations. These factions tend to reflect what has been called the highly personalistic basis of Philippine politics.[15] Factions have also been organized around genuine issues affecting a profession. As

[15] See, for example, Carl H. Lande, Leaders, Factions and Parties: Philippine Politics, Monograph Series No. 6 (New Haven, Conn.: Yale University, Southeast Asia Studies, 1965).

has been shown, in the early development of the Philippine Medical Association there were factions or groups in the Association that represented physicians in government service on the one hand and private medical practitioners on the other. In the dental profession, the early rival organizations represented two different educational traditions -- the older practising dentists representing the Spanish tradition as against the younger, American-educated,dentists. These two associations merged in 1946 to form only one national association, the Philippine Dental Association (PDA). In 1949, however, the organization was split once more around the issue of whether to abolish the practical examination requirement in the dental board examinations. Some members who favored this move, in opposition to the PDA leadership, formed a separate organization, the Federation of Dental Private Practitioners. The Federation presently remains an affiliate of the Philippine Dental Association.[16] Recently, a Philippine Association of Industrial Dentists has also been organized.[17]

The rivalry between government-employed and private sector professionals can also be seen among civil engineers. As discussed earlier in this chapter, there have been two associations of civil engineers since the American regime -- the Philippine Society for Civil Engineers, which has been dominated by civil servants, and the Philippine Association of Civil Engineers, made up mainly of practising civil engineers. In July 1961, a separate Association of Government Civil Engineers of the Philippines (AGCEP) was created.[18] For veterinarians, there are also two professional

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[16] Philippine Dental Association, loc. cit.

[17] "PAID Sets First Annual Convention on May 1," Bulletin Today, 28 April 1977, p. 40.

[18] "How the AGCEP Started," Bulletin Today, 16 June 1977, p. 16.

associations -- the Philippine Veterinary Medical Association and the Veterinary Practitioners Association of the Philippines. The proliferation of professional societies is also seen among the chemists. There is a Kapisanan ng mga Kimiko sa Pilipinas (Association of Chemists in the Philippines), a Chemical Society of the Philippines, a Philippine Association of Chemistry Teachers, an Association of Organic Chemistry Teachers and a Biochemical Society of the Philippines.

The societies in each profession aim to work for the advancement of professional interests and standards of professional practice. Rivalry among these associations for influence in the licensing and regulation of professional practice has been abetted by the important role that was given to these associations by the Reorganization Law of 1932 in the appointments of members to their boards of examiners.[19] Thus, the structure of the licensing and regulation of the professions laid down by the government has been a contributory factor to the postwar proliferation of professional societies in science and engineering. As will be seen later in this chapter, recent changes in the structure for the licensing and regulation of the professions have paved the way for the integration and strengthening of professional societies.

Other Scientific and Technical Societies

There are also scientific and technical societies representing fields of specialized practice which are not covered by separate government licensing and regulatory boards. These are especially prominent in the field

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[19] Act No. 4007, 1932. Section 10 of this law, as amended by Republic Act No. 546 (17 June 1950), provided that the Civil Service Commissioner shall recommend to the President of the Philippines the composition of the various boards of examiners from among persons nominated by the professional associations.

of medicine. The organization of specialty societies was recommended by a resolution of the Philippine Medical Association just before the outbreak of World War II.[20] The proliferation of these societies reflects the increasing trend towards specialization in medical education and professional practice. There are currently over 20 such medical specialty associations.[21] These usually have their own specialty boards which determine and certify the training and competence of their members as specialists in the medical profession. Most of these specialty associations are affiliated with the Philippine Medical Association. Members of these specialty associations are also members of the PMA.

In the field of engineering, there are similar associations representing engineering specialties which are not covered by separate licensing

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[20] Fernando, op. cit., p. 225.

[21] Using newspaper advertisements of professional meetings and the National Science Development Board's list of medical and health societies and organizations for 1976-77, the writer noted the existence of the following specialty associations: (1) Philippine Dermatology Society, (2) Philippine College of Surgeons (3) Philippine Pediatric Society (4) Philippine Obstetrical and Gynecological Society (5) Philippine Academy of Family Physicians (6) Philippine Society of Opthalmology (7) Philippine Heart Association, with the Philippine College of Cardiology as its professional arm (8) Philippine College of Physicians, an organization of specialists in internal medicine (9) Philippine Society of Nuclear Medicine (10) Philippine College of Radiology (11) Philippine College of Tropical Dermatology (12) Philippine Society of Anaesthesiologists (13) Aerospace Medical Association of the Philippines (14) Philippine Society of Pathologists (15) Philippine Association of Plastic Surgeons (16) Philippine Orthopedic Association (17) Philippine Urological Association (18) Philippine Academy of Medicine and Rehabilitation (19) Philippine Society of Otolaryngology and Broncho-Esophagology (20) Philippine Society of Allergology and Immunology (21) Philippine College of Chest Physicians (22) Philippine Society of Nephrology (23) Philippine Society of Neurological Surgeons (24) Philippine Society of Rheumatism (25) Philippine Society of Hematology and Blood Transfusion (26) Philippine Academy of Opthalmology and Otolaryngology (27) Philippine Society of Gastroenterology (28) Philippine Society of Endocrinology and Metabolism and (29) Philippine Leprosy Society.

and regulatory boards. These are the Association of Management and Industrial Engineers of the Philippines, Association of Structural Engineers of the Philippines (ASEP) and the National Society for Seismology and Earthquake Engineering in the Philippines. Members of the ASEP are civil engineers who have specialized in the practice of structural engineering. They are also members of the integrated Philippine Institute of Civil Engineers (PICE).[22] In recent years, there has been a growing move by industrial and management engineers and structural engineers to have their fields recognized as distinct professions with their respective licensing and regulatory boards.[23]

In addition to the scientific societies mentioned above, there are several organizations in the biological and agricultural sciences. These are the Philippine Society of Animal Science, Crop Science Society of the Philippines,Entomological Society of the Philippines, Forest Research Society, Philippine Society for Microbiology, Phytopathological Society of the Philippines, Soil Science Society of the Philippines, and Weed Science Society of the Philippines. There are also associations representing the physical and mathematical sciences. These are the Geological Society of the Philippines, Philippine Astronomical Society, Mathematics Society of the Philippines, Philippine Institute of Physics, Philippine Society of Photogrammetry,and Radioisotope Society of the Philippines.

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[22]The PICE was the result of a merger of the Philippine Society of Civil Engineers and the Philippine Association of Civil Engineers in 1973.

[23]See, for example, Octavio A. Kalalo, "The State of Structural Engineering Profession," Philippine Architecture, Engineering and Construction Record, Vol. 18, No. 6 (September 1971), pp. 20, 22, 24.

As a whole, these scientific and technical societies have been organized to foster scientific research in their particular fields of competence and help facilitate the dissemination of research results among members and the scientific community in general. They also work for the promotion of public interest in their respective disciplines by drawing attention to their activities and projects. In this way, they may attract government support and sometimes succeed in influencing policies.

Aside from the specialized scientific societies, there are multidisciplinary organizations established during the postindependence period. One of these is the Philippine Association for the Advancement of Science (PhilAAS) founded in 1951. Similar to the British Association for the Advancement of Science[24] and the American Association for the Advancement of Science,[25] the PhilAAS is a generalist society which works for the promotion of scientific careers among the youth,the promotion of scientific research and communication among professional scientists and public awareness of the importance and application of science to industry and the country's social and economic development.[26] Its membership includes practising scientists, engineers, physicians and other science professionals as well as laymen interested in science.

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[24]The British Association for the Advancement of Science was founded in 1831. See Sir James Taylor, The Scientific Community (London: Oxford University Press, 1973), p. 13.

[25]The American Association for the Advancement of Science first met in 1848. See Stuart A. Blume, Toward a Political Sociology of Science (New York: The Free Press, 1974), pp. 108-111.

[26]Constitution of the Philippine Association for the Advancement of Science (PhilAAS), preamble, in PhilAAS, 25th Anniversary Convention Souvenir Program (Manila: 27-29 October, 1976), p. 40.

Another interdisciplinary society is the Council of Organizations on Technology and Allied Sciences of the Philippines (COTASP). A confederation of architecture, engineering and other technological societies, the COTASP seeks primarily to facilitate communication and cooperation among its members and to promote the advancement of the engineering profession and allied sciences.[27]

The Professional Regulation Commission

The increasing specialization in the professions has led to the creation of additional boards of examiners to license and regulate professional practice in the Philippines. In 1932, there were only 11 professions or occupations which were covered by government licensing and regulation. In 1950, the number had increased to 16. In that year, Republic Act No. 546 created the Office of the Boards of Examiners.[28] All existing boards of examiners, which were at that time attached to various executive departments, were transferred to the newly created Office of the Boards of Examiners directly under the Office of the President. The President was empowered by the new legislation to appoint all chairmen and the members of the various examining boards from among those recommended by the respective professional associations. The Office of the Boards of Examiners was authorized to promulgate the rules and regulations for the effective implementation of the regulatory laws, to set professional standards for the practice of the different professions as well as to prescribe

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[27] The COTASP was founded in the early 1950s as the Philippine Council for Science and Technology. As of 1976, COTASP had 21 member organizations with about 25,000 individual members. From interview with Mr. Silvestre Javier, International Relations Division, National Science Development Board, Metro Manila, 20 July 1977.

[28] The Act was signed into law on 17 June 1950.

collegiate courses. The Office was also authorized to collect examination and professional registration fees.

As early as 1948, the members of the examining boards had organized the Philippine Association of Board Examiners (PABE). The PABE increasingly saw the need to rationalize the existing government setup for the licensing and regulation of the professions. It, therefore, worked for the creation of a distinct office that would look after the licensing and regulation of the professions. By 1963, the number of government examining boards had increased to 28.

On 22 June 1973, the PABE witnessed the culmination of its campaign for a better organization of professional licensing and regulation with the issuance of Presidential Decree No. 223. The Decree created a three-member Professional Regulation Commission to administer, implement, coordinate and supervise the 32 examining and regulatory boards.[29] Members of the Commission are to be appointed by the President for a term of nine years from professionals who are at least forty years of age, who are familiar with the principles and methods of professional regulation and/or licensing, and have had managerial experience.[30]

The Professional Regulation Commission has the power to administer, implement and enforce the policies of the national government with respect to the regulation and licensing of the professions and occupations under

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[29] Aside from the 26 examining boards for the science and engineering professions discussed above, there are also boards of examiners for accountancy, social workers, master plumbers, licensed contractors, marine engine officers and marine deck officers and customs brokers.

[30] Appointed as first Commissioner to head the newly-created office was Eric Nubla who was at that time President of the PABE and Chairman of the Board of Examiners for Architects. The Associate Commissioners are Jose A.R. Melo and Eduardo R. Gullas.

its jurisdiction. It conducts the licensure examinations of the various boards according to the regulations fixed by the latter. It maintains a register of practitioners and issues certificates of registration or licenses. It has the power to recommend to the President of the Philippines persons for appointment as members of the examining boards from names submitted by the bona fide professional organizations accredited by the Commission. The Commission also has the power to prescribe or revise, in conjunction with the board concerned and the Secretary of Education and Culture, the courses which must be completed before one can take the appropriate licensing examination.[31]

Each professional examining board retains the power to look into the conditions affecting the practice of their respective profession, and to adopt measures for the enhancement of the profession and the maintenance of high professional and ethical standards. This power includes inspections and visitations to determine compliance with the laws governing professional practice and as an aid in the formulation of new policies and regulations. The boards also retain the power to investigate violations of their laws, rules and regulations, to prepare licensing examinations and to rate examination papers.[32]

On 9 December 1974, the Commission issued its "Rules and Regulations Governing the Regulation and Practice of Professionals."[33] The Rules provide for a Curriculum Review Unit to undertake a regular review of courses required for taking the appropriate professional board examination.

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[31] Presidential Decree No. 223, Sec. 5.

[32] Ibid., Sec. 6

[33] Official Gazette, Vol. 71, No. 4 (27 January 1975), pp. 407-416.

This is done with the assistance of board members concerned, representatives of the Department of Education and Culture and other educators acting as consultants. This formal review mechanism enables the Commission to prescribe and revise collegiate courses considered essential to the professional education and training of engineers, scientists and physicians. Under the old setup, some of the examining boards performed this function without consulting the members of the profession or the academic sector. Since board members are required by the professional regulatory laws to be older members of their professions (with at least five to ten years practice) and are forbidden to have any connections with any of the colleges or universities, their decisions regarding collegiate curriculum were often criticized as being outmoded or even irrelevant to the existing educational and social conditions.

In order to integrate and strengthen the existing professional associations, the Commission's Rules provide that each profession will be represented by only one accredited national organization.[34] To be accredited as the bona fide professional organization, an association must have been established for professional ends and not for profit or business enterprise; have a substantial number of members; must be homogeneous, being composed of licentiates of one particular profession only; and must be national in scope with members coming from various parts of the country. Each accredited professional organization will have the exclusive privilege of nominating its members to the Commission for appointment by the President of the Philippines to their regulatory boards. Only such an organization can endorse to the Commission the holding of seminars, workshops or

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[34] "Rules and Regulations Governing the Regulation and Practice of Professionals," Art. IX in <u>ibid</u>.

lectures designed to advance knowledge or proficiency in its professional field. This is expected to stop the reported practice by unscrupulous groups of holding continuing education programs solely for profit.

These new regulations have had the effect of forcing professional societies to integrate for licensing purposes. The earlier societies continue to retain their identities but the Commission will only deal with the accredited organization for licensing and professional regulation. As of August 1977, 26 integrated professional organizations have been accredited by the Commission. These have formed the Federation of Accredited Professional Organizations of the Philippines for the purpose, among others, of "promoting professional interdisciplinary collaboration and interaction to keep abreast with developments in the rapidly changing world" and to "galvanize a multi-professional approach to the economic, social, educational and techno-scientific problems of the nation."[35]

The Professional Regulation Commission has, moreover, been studying the feasibility of making compulsory membership in good standing with the accredited professional association as an additional requirement for continued registration of members of a profession. This is because professional associations, with the exception perhaps of the Philippine Medical Association, have generally had few members relative to the total number of registered professionals. The Commission has already made membership in these professional associations a requirement for its annual awards of outstanding members of each profession.

To further improve the state of the professions, the Commission has been working for the enactment of a Professional Regulation Code that would

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[35] "Constitution and By-Laws" of the Federation of Accredited Professional Organizations of the Philippines, Article II, Sec. 1.

integrate the different professional licensing and regulatory laws in the country. As of August 1977, it had given a draft of the proposed Code to the accredited professional organizations for their comments and approval preparatory to its submission to the President for his signature and issuance as a presidential decree.[36] Its approval is expected to help facilitate a more effective regulation of the professions.

Role of Professional Associations in the Education and Training of Members

Professional scientific and engineering societies have been active in helping to upgrade the standards of education and professional practice in their respective fields of specialization.[37] In many cases, these societies have been instrumental in working for the enactment or

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[36]The Commission consulted the Law Center of the University of the Philippines in the preparation of the proposed Code. The Law Center had recommended that the Commission should also consult with the appropriate deans, faculty and university or college officials regarding provisions of the proposed Code which would affect their programs of study.

[37]These generalizations are based on questionnaire/interview data from officers of 13 integrated and accredited professional organizations supplemented by newspaper clippings on professional activities. These organizations are: Dietetic Association of the Philippines, Geological Society of the Philippines, Institute of Integrated Electrical Engineers of the Philippines, Integrated Chemists of the Philippines, Philippine Institute of Chemical Engineers, Philippine Institute of Civil Engineers, Philippine Medical Association, Philippine Nursing Association, Philippine Society of Agricultural Engineers, Philippine Society of Mechanical Engineers, Philippine Society of Mining, Metallurgical and Geological Engineers, Philippine Society of Sanitary Engineers, and Society of Filipino Foresters. Because of overlapping membership in the professional scientific and engineering societies, the questionnaires/interviews also yielded information on the following organizations: Association of Government Civil Engineers in the Philippines, Association of Government Mechanical and Electrical Engineers in the Philippines, Association of Structural Engineers in the Philippines, National Society for Seismology and Earthquake Engineering, Philippine Association of Civil Engineers, Philippine Association of Mechanical and Electrical Engineers, Philippine College of Surgeons, Radioisotope Society of the Philippines, Geographical Society of the Philippines, and Soil Science Society of the Philippines.

amendment of laws creating boards of examiners for their professions and revising their collegiate curricula to meet with changing conditions. In performing this function of self-regulation, they resemble the professional societies in the industralized countries, particularly in the United States.[38]

The strength of each association has varied with the length of time that it has existed and the size of its membership. The latter has depended to a very large extent on the number of graduates that has been produced by the country's educational institutions and the prestige of the profession. Thus the Philippine Medical Association, for example, because of its long history, the social prestige of the medical profession and the large number of physicians produced in the country has been able to develop a strong mass-based organization. Engineering societies have likewise developed relatively large organizations. The small number of graduates in the sciences explains the fewer membership and relative weakness of such societies as the Philippine Institute of Physics, Soil Science Society of the Philippines and others. The leadership in the professional and scientific societies has generally been drawn from Manila because of the concentration of engineers, scientists and physicians in the metropolitan area as shown in Chapter II. This concentration is in turn due to the presence of most of the national government offices, the largest universities and colleges, and the bulk of the country's business and industrial

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[38]Except for the Society of Filipino Foresters, all the respondents in the questionnaires/interviews specified that the structure of their profession was modeled after those found in the United States. The respondent for the Society of Filipino Foresters indicated that their profession was modeled after other Philippine professions such as the medical and engineering professions.

corporations in the area.

The professional associations have generally helped to create a sense of community among their members through their various meetings and activities. Each association holds annual national conventions which are not only social occasions but also provide a means of continuing education for members as these usually include presentation/discussion of scientific and technical papers and current issues affecting the profession. In addition to these annual conventions, there are monthly or quarterly scientific and technical seminars at the national or regional levels. These gatherings are often widely publicized in the national newspapers. The amount of newspaper space devoted to these activities can give an idea of the professional association's resources devoted to these gatherings and the attendance of members. The Philippine Medical Association's annual conventions and those of the various medical specialty associations usually occupy one or two pages of newspaper space while those of the other scientific and engineering societies may occupy only a few column inches of space.

Each scientific society also publishes its own organ -- a quarterly journal, monthly bulletin or newsletter. The frequency and regularity of these publications vary with the stability and resources of the professional association or scientific society. The PMA, for example, has been able to publish its monthly PMA Journal since 1924. The Philippine Society of Civil Engineers has come out with its quarterly Philippine Engineering Record since 1939. Other engineering societies have been able to publish their own journals by securing the support of the private sector and other associations.[39] More recently, some of the smaller scientific societies in the biological and agricultural sciences have received financial assistance for their journals from the Philippine Council for Agriculture and Resources Research (PCARR).[40]

Professional associations influence the standards of education for their respective fields by informal as well as formal mechanisms. Association meetings usually bring together the academic and practicing members of the profession. These provide opportunities for discussing current developments in the profession and how these can be incorporated in the existing courses offered in the colleges and universities. Formally, the professional association can suggest the revision of existing curriculum to the Department of Education and Culture. Sometimes the initiative comes from the members of the board of examiners for the profession. They formulate the proposed curriculum changes which are then submitted to the professional association and the different schools for comments and suggestions. The reactions of these different groups are then taken into consideration. If new legislation is needed to implement the changes, the professional association drafts the proposed law and submits it to the proper authorities for their decision.

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[39] For example, the monthly Philippine Architecture, Engineering and Construction Record has been published since 1954 with the support of the Philippine Contractors Association, and the quarterly Philippine Architecture and Building Journal, since 1959, has been published by C.F. Agbayani and Sons for the Association of Philippine Government Architects and other Associations.

[40] The quarterly Philippine Journal of Veterinary and Animal Science, a joint publication of the Philippine Society of Animal Science and the Philippine Veterinary Medical Association, received a grant of ₱44,000 in 1976 while the Crop Science Society of the Philippines received a grant of ₱50,000 in order to start the publication of the Philippine Journal of Crop Science, a quarterly. See "Crop Science Journal Gets PCARR Support," PCARR Monitor, Vol. IV, No. 1 (January 1976), p. 16.

The success of the professional associations in influencing the direction of education and training of their members has to a large extent depended on the strength of its organization, i.e. the size of its membership and the degree of cooperation between the leadership of the professional association and the members of its professional examining board. The Philippine Medical Association, for example, because of its long history as a national professional organization, its mass-based membership and effective leadership has been able to establish reliable channels for initiating and influencing policies affecting the education and training of physicians in the country. Other professional organizations, because of their limited membership, existence of factions, or rival organizations within the profession have not been as effective as the PMA.

The Philippine Medical Association and Medical Education

The Philippine Medical Association has been instrumental in determining the requirements for medical education and training and improving the standards of medical schools in the country. As early as 1946, it moved for the strengthening of the preparatory course for medical students. It worked actively for the addition of courses which lengthened the premedical curriculum from two to three years starting in school year 1954-55. In 1959, it succeeded in making the four-year bachelor's degree the premedical requirement.[41] As a consequence of these changes, the medical degree could be attained only after nine years of study, i.e. four years preparatory course, four years of medicine proper and a year of

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[41]This was embodied in the Medical Act of 1959, Republic Act No. 2382 (20 June 1959) as amended by Republic Act No. 4224 (19 June 1965).

internship compared with the original six-year course.

The Medical Act of 1959, as amended, was the culmination of several years of campaigning by the Philippine Medical Association to update the regulations governing the licensing and regulation of the medical profession. It was drafted by the PMA with the active participation of the Council of Deans of Medical Colleges in the Philippines. The Act was passed by Congress but was vetoed by President Carlos P. Garcia in 1957. The Association continued its lobby for the Act's enactment. It was reintroduced and finally signed into law in 1959. The Act institutionalized the PMA's influence over medical education and control over the licensing and regulation of the profession through its formal representation in the Board of Medical Education and its exclusive right to submit a list of twelve names to the President of the Philippines from which he would appoint the six members of the Board of Medical Examiners.[42]

The Board of Medical Education created by the new legislation is attached to the Department of Education and Culture.[43] It is responsible for ensuring compliance among the medical colleges with the established standards of medical education in the country. The Board is empowered to determine and prescribe requirements for admission into a recognized college of medicine; minimum physical facilities of colleges of medicine

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[42] Republic Act No. 2382, Secs. 3 and 13, as amended by Republic Act Nos. 4224 and 5946 (23 June 1969).

[43] The Board of Medical Education is composed of the DEC Secretary as Chairman, the Secretary of Health, the Director of the Bureau of Higher Education, the Chairman of the Board of Medical Examiners, the Dean of the College of Medicine of the University of the Philippines, the President and the Executive Director of the Association of Philippine Medical Colleges and a representative of the Philippine Medical Association.

i.e. buildings including hospitals, equipment and supplies, apparatus, instruments, appliances, laboratories, bed capacity for instructional purposes and so on; minimum number and qualifications of teaching personnel, including student-teacher ratios; and the minimum required curriculum for the degree of Doctor of Medicine. The Board can authorize the implementation of an experimental medical curriculum in a medical school that has exceptional faculty and physical facilities. Such experimental curriculum may prescribe admission and graduation requirements other than those prescribed in the Medical Act of 1959. The Board also certifies students seeking admission to a medical school and keeps a register of those issued such certificates. Moreover, it determines which hospitals are sufficiently equipped for training purposes.

Along with its campaign to strengthen premedical education, the Philippine Medical Association has worked for the elevation of standards of education in the existing medical schools. The first task it undertook was to work for the reduction of the inflated enrollments in the private medical schools, partly brought about by the availability of educational benefits for war veterans and their dependents. The Association initially acted through the Board of Medical Examiners. It adopted a plan to limit freshmen admission for all the six private medical schools in 1958 to 2,7000 students. This was designed to reduce the size of classes in these schools and thus ensure adequate laboratory facilities, clinical experience for students and lower student-professor ratios.[44] The PMA

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[44]The formula adopted in 1958 set the ceilings for freshmen admission to 1,000 students for the University of Santo Tomas, 700 for Far Eastern University, 300 for Manila Central University, 300 for the University of the East and 200 each to the Cebu Institute of Medicine and Southwestern University College of Medicine. The University of the Philippines maintained its admission level of 100 freshmen students. See Stauffer, _op_. _cit_., pp. 36-37.

plan was sent to the different schools through the Board of Medical Examiners. It prevented as many as 2,000 students from entering medical school in 1958.

In 1962, the PMA renewed its campaign to reduce enrollments in the private medical colleges. The Department of Education supported PMA's move and together worked out a formula that would govern annual admission of students and set student-teacher ratios in medical schools. The PMA's proposal was based on one of its committee's study and was adopted by the Board of Medical Education. The Board required schools to reduce their freshmen enrollment by 25 per cent every year until a maximum number of 300 freshmen in any school would be reached.[45]

In its continuing work to upgrade the standards of medical education in the country, the PMA has been greatly aided by the Association of Philippine Medical Colleges (APMC). Formally organized in 1967, APMC began as the Council of Deans of Philippine Medical Schools in 1957.[46] One of APMC's principal goals is the upgrading and standardization of the medical schools. It has, therefore, worked closely with the Board of Medical Education in setting up a system of accreditation for these. It is represented in the Board by its President and Executive Director. Thus

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[45] Department of Education and Culture, Board of Medical Education, Annual Report, Fiscal Year 1968-69 (mimeo.), pp. 2-3. In 1969, it was expected that three private schools would have a ceiling of 300 freshmen while the other three would have 200 freshmen each. The Filemon D. Tanchoco Memorial Medical Foundation of Manila Central University voluntarily cut down its admission from the 200 set for it by the Board to only 100 freshmen students annually.

[46] The APMC is composed of institutional members, i.e. medical colleges in the Philippines, as well as individual members, i.e. faculty members of these colleges. Seven medical schools were signatories to the Association, five of these are full members while two are provisional members. Institutional membership in the APMC is essentially a form of accreditation.

it has been able to influence, or, alternatively has been influenced by the Board in regard to medical education policies.

APMC actively participated in the drafting and final enactment of the Medical Act of 1959, and its amendments in 1969. The 1969 amendments reduced the five-year medical curriculum by removing the fifth year internship requirement for the Doctor of Medicine degree.[47]

Under the new medical curriculum which became effective in 1972, all academic courses are now taken up in the first three years. The fourth year is devoted to technical training in university hospitals (called a full clerkship) after which the student gets his medical degree. The M.D. qualifies him to engage in teaching and/or research but not to practice the profession. To register as a medical practitioner, the new graduate needs another year of technical training or internship in accredited hospitals and clinics throughout the country and must also pass the medical board examinations. The APMC has been delegated by the Board of Medical Education with the responsibility of matching the post-M.D. interns with the accredited training hospitals.

In its goal to help standardize medical education in the Philippines, the APMC drafted and worked for the enactment of Republic Act No. 4056 in June 1964. The Act authorized a government subsidy of ₱3 million annually to private medical colleges which maintain a standard of medical education that is acceptable to the Board of Medical Education. To receive the subsidy, a medical school must be accredited by the Board and

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[47]Republic Act No. 5946, 23 June 1969. This restructuring of the undergraduate medical curriculum created quite a controversy within the profession when it was first proposed by APMC. Reactions to the proposed curriculum has been documented in the papers and proceedings of the First National Conference on Medical Education which was called by APMC in 1968.

hence must become a full member of APMC.[48] Because of the increasing costs of laboratory equipment, library materials and medical supplies, private medical schools have found it difficult to maintain their standards without regularly increasing tuition fees. The APMC, therefore, further proposed the creation of a Medical Assistance Trust Fund from various sources to subsidize medical schools and hospitals.[49] This fund would be used to help the medical schools improve facilities and upgrade faculty through staff development programs. The APMC has been assisting medical schools with the training of medical faculty through a program set up at the University of the Philippines College of Medicine. The APMC also arranges postgraduate courses and seminars on special topics for deans and faculty of medical schools.[50] Moreover, since 1971, it

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[48]The money comes from the proceeds of one sweepstakes draw a year which was authorized by the same law. Although the Act authorized a subsidy of ₱500,000 per school each year, all that the private colleges received from 1967 to 1970 was an average of ₱45,500 annually. See Republic of the Philippines, Senate, Committee on Education, Higher Education Research Council, "Report of the Consultant Committee on Medicine," 1970 (mimeo.).

[49]Association of Philippine Medical Colleges, "A Brief for the Creation of a Medical Trust Fund," submitted to the Senate, Committee on Education, Higher Education Research Council, 1970 (mimeo.).

[50]For example, in April 1970, it made possible a one-week seminar on family planning in Baguio City for medical faculty. The seminar was funded by the U.S. Agency for International Development, through the Department of Health, at the request of the APMC. A Continuing Pediatric Education Improvement Program with financial support from the Josiah Macy, Jr. Foundation was also set up in 1969 and is an ongoing APMC program. In May 1972, the APMC called the Second National Conference on Medical Education in Manila. The APMC also has continuing projects on textbook writing for pediatrics, obstetrics and gynecology. From interview with Dr. Victor Valenzuela, Executive Director, APMC, Manila, 31 August 1977.

has set up demonstration clinics in some of the medical colleges.[51]

More recently, the APMC has been deliberating on further amendments to the Medical Act to make the curriculum more relevant to the country's health needs. It has proposed, for example, a two-year rural service for medical graduates who have newly passed the medical board examinations. Under the proposal, they would initially be given limited license to practice in the rural areas. This would encourage them to accept government service. After completing this rural service, the new M.D. can then be given his full license. Aimed at providing more medical workers in the rural areas and at helping stem the emigration of the country's newly-trained physicians, the proposal awaits discussion.[52] There is also a move to devote more time in the medical curriculum to the study of infectious diseases.

As a consequence of the continuing dialogue among medical educators and members of the profession through APMC, medical schools have been expanding the exposure and training of medical students in comprehensive

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[51]Family planning demonstration clinics were set up in the colleges of medicine of the University of the Philippines and Far Eastern University. Rural community health demonstration clinics were similarly organized by APMC in the Cebu Institute of Medicine and the University of the East Ramon Magsaysay Memorial Medical Center.

[52]Interview with Dr. Valenzuela, _op. cit._

community health, population and family planning programs.[53] Discussions of issues affecting medical education are inevitably brought into the Philippine Medical Association meetings and conventions since members of APMC are concurrently active members of PMA. It may be no coincidence that the Executive Secretary of the APMC was also chosen as the Chairman of the Medical Education Committee of the PMA in 1977.

In the 1970s, the medical profession in the Philippines has been increasingly concerned with the problems of concentration of medical practitioners in the urban areas and the brain drain of medical graduates to the United States and Canada, while much of the medical needs of the rural population remain unattended. Serious consideration has, therefore, been given to possible changes in the medical curriculum, from the urban, hospital-centered basically Western concept of medical training, to one that is more relevant to the country's needs. The possibility of shortening the nine and one-half years of medical education has been proposed by a former president of the Philippine Medical Association who became Commissioner of the Philippine Medical Care Commission for the private

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[53] Medical students at the University of the Philippines, for example, since 1965 have to spend eight weeks of their fourth year clerkship in a rural area in Laguna. See Dr. Sergio S. Gasmen, "Comprehensive Community Health Program," paper read at the National Seminar on Educational Innovations for Development (Manila: 5-6 January 1976), Department of Education and Culture, sponsored by the National Development Group for Educational Innovations and National Research and Development Center for Teacher Education and UNESCO-ACEID, Bangkok, Thailand. The University of the East Ramon Magsaysay Memorial Medical Center College of Medicine has likewise put up its Limay Community Health Projects as the locale for the training of its medical students.

The Cebu Institute of Medicine has similarly set up four types of community medicine programs for its senior medical students -- the rural service model for municipalities and barrios linked with the Rural Health Units of the government, the urban service model for urban slums in Cebu City, hospital-based community medicine, and community-based community medicine which involves living in barrios where they practice. Senior students spend two weeks in each program. See Cebu Institute of Medicine, Bulletin of Information, 1976-77, pp. 28-29.

sector. He noted that most European countries had already shortened the medical course to six years.[54]

The question of relevance of the existing medical curriculum led medical educators at the University of the Philippines to set up an experimental program at its campus in Tacloban, Leyte. Started in June 1976, the new curriculum seeks to provide health manpower that will be better prepared to work in rural health centers (which serve 70 per cent of the country's population) rather than urban hospitals in the Philippines and the developed countries of the world. The curriculum is structured in such a way that students who are forced to drop out at a certain stage of the program can still be qualified to deliver a particular level of health care.[55]

Students in the new UP Institute of Health Sciences are selected and nominated by their local communities in which they are required to serve upon graduation or on completion of any year in the training course. The curriculum includes courses on medicine, surgery, publich health and the behavioral sciences which will enable students to take qualifiying

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[54]"Shortening of RP Medical Course Urged," Bulletin Today, 6 November 1976, p. 1. The Bulletin supported the proposal in its editorial on 7 November 1976, pointing out that many of the Filipino physicians who were successfully practising at home and abroad were products of the shorter curriculum.

[55]The first one and a half years of the curriculum will qualify a student to be a midwife. After two and a half years, he can qualify as a public health nurse and with three more years, he will be granted the degree of bachelor of science in rural medicine. From then on he will be qualified to deliver limited medical care in his barangay or barrio. He will be alternately serving his barangay part of the time and attending school for three more years to qualify for a doctorate in medicine. This would make him a full-fledged physician, qualified to take the medical board examinations in order to be licensed as a practitioner.

board examinations for midwifery, nursing and medicine.[56]

The experimental medical curriculum is unique in that it avoids wastage of medically-trained manpower by enabling students to qualify for the delivery of a certain level of health care and medical services at different stages of their training. Thus, those who drop out of the school will always find their training useful when they go back to work in their communities. Under the existing medical curriculum, students who drop out after several years in medical school can not qualify for suitable jobs unless they reenroll for a few more years in allied courses such as nursing, medical technology, occupational therapy or dentistry. What usually happens is that they get clerical jobs or become detailmen of the pharmaceutical firms thus wasting their years of professional education. Medical educators behind the new school allay fears of lowered professional standards by pointing out that the existing medical curriculum will still be needed to train medical teachers, the basic medical scientists and medical specialists.

The PMA has taken cognizance of the importance of the experimental medical curriculum. In 1977, the PMA president publicly endorsed the full implementation of the four-year course in rural medicine at the 70th PMA National Convention.[57] It is just a matter of time, therefore, before

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[56] The new curriculum has been discussed for several years by medical professors at the University of the Philippines and somewhat inspired by the success of China's "barefoot doctors". It has been made possible by support of the present Government involving such agencies as the Department of Health, the Medical Care Commission, the Department of Local Government and Community Development, the National Economic and Development Authority and support from the World Health Organization. Alberto Rous, "Tacloban Experiment: School Trains Rural Doctors," Times Journal, 16 August 1976, pp. 1 and 8; Domini Torrevillas-Suarez, "Barefoot Doctors," Philippine Panorama, 29 August 1976, pp. 6-9.

[57] "Endorse Medical Program," Bulletin Today, 17 April 1977, p. 24.

these changes in medical education will be adopted on a national scale.

The success of PMA as a professional association in influencing policies for the education and training of members has been due to the prestige of its leadership as well as its large membership. As of 1977, an estimated 13,000 of the country's registered physicians are members of PMA.[58] Membership with PMA has been supported by official sanctions that have been incorporated in PMA-sponsored legislation. The PMA, for example, lobbied continuously for the adoption of a government medical care program as early as 1960. In 1969, PMA finally saw the enactment of Republic Act No. 6111 which created the Philippine Medical Care Commission. The legislation created what is essentially a national health insurance scheme and thus assured practicing physicians of a more stable source of income. Under the Medicare Law, only members of good standing of the Philippine Medical Association can practice under the Medicare Program. Membership of good standing has been defined by PMA as paying annual membership dues and attending at least 50 per cent of continuing medical education sessions sponsored by the component society or the PMA during the immediately preceding year. Through the enactment of the Medicare Law the PMA has, therefore, succeeded in strengthening its existence as a professional association and increasing its influence on the members of the medical profession.[59]

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[58] By 1975, there were 37,276 registered physicians in the country. As the registry is cumulative since the Board of Medical Examiners was created, the list included those who have retired, are deceased or out of the country. See National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 572-573.

[59] In 1976, for example, some 2,600 physicians who were listed in bad standing by the PMA were advised by the Philippine Medical Care Commission to change their status with the Association or lose their practice with Medicare. "2,600 Doctors May Lose Out on Medicare," Bulletin Today, 8 August 1976, p. 24.

What emerges from this discussion of PMA activities, in relation to its members and component societies, is that PMA's success as a professional organization has been greatly enhanced by the enactment of various laws that it had sponsored or supported in the past. In working for the adoption of these policies, PMA ensured legal sanctions for its involvement in decision making over matters affecting standards of education and training as well as professional practice of members. Through these legislation, it has also reinforced its effective hold on the professional standards and ethics of members.

PICHE and Revision of Chemical Engineering Curriculum

Among the professional engineering societies, the Philippine Institute of Chemical Engineers (PICHE) has been the first to take up the problem of updating the chemical engineering curriculum as one of the subjects for its annual national conventions. Discussions about the need for a new curriculum began as early as 1968 when the Board of Examiners for Chemical Engineering issued a resolution which amended the topic coverage and relative weights of the principal subjects normally given in the Board examinations.[60] This resolution was circularized by the Board to all colleges offering the chemical engineering degree during the latter part of 1968. The resolution introduced new topics or subjects which had not yet been fully explored or emphasized by most colleges in curricular programs.

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[60] Resolution No. 7, Series of 1968. Interview with Miss Lydia Tansinsin, President of PICHE and also Chief of the Planning and Programming Division of the National Science Development Board, Metro Manila, 17 May 1977.

In March 1969, a conference between the Board of Examiners and representatives of colleges in the Metropolitan Manila Area was held to discuss the mechanics of implementing the new resolution. Ranking officers of PICHE, the Women Chemical Engineers of the Philippines and representatives of the Bureau of Private Schools attended the conference. There was a consensus among the group that there was a need to revise the curriculum requirements which had been in effect for almost 15 years in order to keep it abreast of recent developments in chemical engineering education and advances in technology. It was felt that the curriculum should be restructured to make it "more efficacious and responsive to the needs at the national as well as local levels, more relevant to modern objectives in chemical engineering education and flexible enough to absorb or accomodate any future trends or new developments."[61]

An outcome of the conference was the creation of two regional study groups composed of the representatives of PICHE and the various colleges operating around Manila and Cebu City. The two groups proposed an updated core of subjects to compose important areas of study in the new curriculum. The PICHE, through its regional chapters, coordinated and supervised the study groups' work for reviewing the curriculum. The study groups' findings were presented to the PICHE National Convention in Cebu City from 27 to 29 June 1969. Representatives of 21 colleges offering chemical engineering programs, members of the Board of Examiners for Chemical Engineering, representatives of the Bureau of Private Schools,

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[61]Eduardo V. Gutierrez, Chairman, Ad Hoc Committee on Curriculum Revision, PICHE, "The Revision of the Cirriculum Requirements for Chemical Engineering," a report submitted to the Bureau of Private Schools, Department of Education, 19 March 1970, typescript.

the industrial and business sectors attended the Convention and discussed the subject content and instructional approaches of the curriculum. The proposed curriculum was approved by the Convention. A committee composed of delegates from the Manila colleges was appointed to work out the details of the curriculum structure and course information on each subject. The committee's work was later presented and approved at another engineering education workshop in Iloilo City in November 1969. The new curriculum was finally submitted to the Director of Private Schools and the Secretary of Education for approval and implementation.

The PICHE is continuing its work of helping to update the chemical engineering curriculum. The addition of bio-engineering as a subject in the curriculum and in the board examinations was initiated by PICHE and the Board of Examiners, working with the Department of Education in 1974. The PICHE has also been discussing the possibility of introducing more subjects on environmental pollution and control into the chemical engineering curriculum as the members of the profession feel that these are very much needed with the development of the country's natural resources and industry. In its Convention on 3-5 June 1977 in Cagayan de Oro City, a model curriculum proposed by the University of San Carlos incorporating subjects that had been previously taken up in previous PICHE conventions was discussed. The delegates also passed a resolution to remove Spanish as a compulsory subject for chemical engineers. In its place, they have recommended the substitution of new subjects as technical electives.

Activities of Other Engineering Associations
Affecting Education and Training of Members

Other professional engineering associations have not been as active as the Philippine Institute of Chemical Engineers in taking the initiative to help shape the educational program for members of their profession. Civil engineers, for example, have been hampered in the past by the initial lack of unity in professional organization. As has been noted, there have been several rival professional organizations among civil engineers. It was only in 1973 that a unified Philippine Institute of Civil Engineers was established. Prior to this, civil engineers represented by the Philippine Association of Civil Engineers (PACE) and the Association of Structural Engineers of the Philippines (ASEP) had worked together to draft a uniform Structural Code which was adopted by the Civil Engineering Board of Examiners in 1972. Preparation of the Code had received concerted efforts because of the earthquake disasters in 1968 that caused buildings to crack and collapse in Manila. Poor civil engineering was blamed for the collapse of an apartment building that killed 300 persons. Before the adoption of this Code, various codes were being used in courses for engineering and architecture students in different schools. In 1972, a National Building Code was enacted by Congress.[62] This was hailed by members of the civil engineering and allied professions as an important step towards better professional regulation.

Because of the country's location in the circum-Pacific seismic belt and typhoon area, civil engineers who are members of the ASEP have been campaigning for the regulation and restriction of the practice of structural engineering as a specialized profession. According to one of the leading proponents of the professionalization of structural engineering,

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[62] Republic Act No. 6541, June 1972. The Act was never implemented but was revised by a Task Force appointed by the President and reenacted as Presidential Decree No. 1096 issued on 19 February 1977. In the preparation of the Code, representatives of various engineering professions were consulted.

the existing curriculum for civil engineering prepares a prospective practitioner with the capability to design only very simple structures.[63] Thus a civil engineer should undergo further specialized training before he could qualify to practice structural engineering.

A proposed law regulating structural engineering has been opposed by many civil engineers. A big group of private civil engineers in Mindanao, for example, argue that this will "reduce them to lowly draftsmen of accredited structural engineers." They claim that it "would exclude 15,000 civil engineers out of profitable employment and place them at the mercy of structural engineers who number only 150 throughout the Philippines with Mindanao having not even one practitioner."[64] Moreover, they point out that most of structures planned and designed by civil engineers have withstood damage from recent earthquakes in Manila and Mindanao. The controversy over structural engineering remains unresolved up to this time.

While the professional engineering associations have not been taking the initiative to work for the revision of their respective college curricula, their members participated in some of the seminars and workshops that were called for the purpose by the Department of Education and Culture in 1973-74. These meetings were attended by DEC officials, deans of

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[63] He argued that the subjects on structural design for civil engineering students, for example, consist only of five units of engineering mechanics, five units of strength of materials, five units of theory of structures and 17 units of timber, steel, concrete and foundation designs. In his view, these are inadequate for structural engineering. See "Regulate Structural Engineering -- Kalalo," Bulletin Today, 6 July 1977, p. 17; Ben T. Lara, "It's time to Regulate Structural Engineering," Bulletin Today, 31 August 1977, p.7.

[64] "Buck Proposed Engineering Law," Bulletin Today, 26 July 1977, p. 30.

engineering schools, faculty members, members of examining boards for engineering and representatives of industry. The outcome of these dialogues was the adoption of a "Revised Five-Year Civil, Electrical and Mechanical Engineering Curriculums, 1973-74" for uniform use by private engineering colleges. The document contains minimum core curricula with the corresponding course outlines which would be used by universities and colleges in developing their own programs.

In 1975, the government initiated an engineering education development project to be financed by a loan from the Asian Development Bank. The project aims to improve the quality of undergraduate education in the four basic disciplines of civil, mechanical, chemical and electrical engineering in the Philippines. Specifically, the proposed project seeks, among others, "to rationalize engineering education to make courses more relevant to national needs" and "to increase the exposure of future engineers to actual work situation to effect better application of technologies and appreciation of practical skills."[65] The Educational Development Projects Implementing Task Force (EDPITAF) of the Department of Education and Culture, in consultation with the Asian Development Bank, has chosen 20 engineering schools located in various parts of the country to participate in the engineering education project. These schools will be extended soft, long-term loans from the government's own loan from the Asian Development Bank. They will be able to use the proceeds from this loan for public works and the construction of laboratories, classrooms

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[65] Republic of the Philippines, Department of Education and Culture, Educational Development Projects Implementing Task Force, Annual Report, 1976, p. 52.

and related facilities, purchase of teaching equipment, library materials and international and local fellowships for faculty members and management staff.

In the preparation of this project, the EDPITAF conducted a series of seminar-workshops in 1975 on engineering education to determine priorities in engineering education and to develop strategies to meet these priorities. These seminars were attended by engineering deans, selected faculty members, representatives of industry and the members of the engineering boards of examiners to discuss three areas of concern, namely, laboratory experiment designs, standards for facilities and laboratories in science and professional engineering work, and the necessary staff development programs for improving engineering education.

The project also involves the establishment of a Technical Panel on Engineering Education as a staff agency of the Bureau of Higher Education in the Department of Education and Culture, the creation of a national accreditation system to evaluate engineering courses offered by schools, the establishment of a National Engineering Center in the University of the Philippines and a Master of Engineering Education program in the latter's College of Engineering.[66] There is thus an emerging pattern of closer consultation between the Department of Education and Culture, the members of the examining boards, the academic community and professional engineering societies in determining the needs and direction of professional engineering education.

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[66]The Technical Panel on Engineering Education will administer the national accreditation system. The National Engineering Center will undertake, sponsor and coordinate programs of staff training, curricular development, and the design and distribution of improved teaching equipment and materials. See <u>ibid.</u>, <u>passim</u>.

Most of the professional engineering associations have been active in providing continuing education for their members. Seminars and symposia are usually organized to discuss new developments in the profession and thus update members' competence in their respective fields. These are quite evident in the press releases issued by the associations and the news coverage given to these activities.[67] Some engineering associations such as, for example, the Philippine Association of Mechanical and Electrical Engineers (PAMEE) and the Philippine Institute of Civil Engineers (PICE) have scholarship awards for undergraduate or graduate engineering students in their fields of specialization.[68] The Philippine Association of Geodetic Engineers has been cooperating with the National Manpower and Youth Council in the preparation of the latter's Geodetic Engineering Aides Training Program. The program will train out-of-school youth and dropouts from engineering courses as geodetic engineering aides.[69]

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[67] For example, in 1976-77, the Integrated Institute of Electrical Engineers held symposia on nuclear, geothermal and solar energy; the Philippine Institute of Architects held seminars on "Fire Safety in Architectural Design" and the "New Building Code," and the Philippine Institute of Mechanical Engineers conducted preboard review classes for mechanical engineering graduates. See "Symposia on Nuclear, Geothermal and Solar Energy," Bulletin Today, 24 November 1976, p. 39; "Plan Seminar on Fire Safety," Bulletin Today, 13 May 1976, p. 24; "Seminar on the Building Code," Bulletin Today, 31 July 1977, p. 5; "Review Classes for Engineers," Bulletin Today, 17 July 1977, p. 16.

[68] The PAMEE donated two undergraduate scholarships at the U.P. College of Engineering in 1976-77. See University of the Philippines, College of Engineering Catalogue, 1976-77, p. 28; the PICE has a scholarship program for deserving engineering graduates to pursue graduate studies. See "₱3-M Science, Technology Complex to be Constructed," Philippines Daily Express, 13 May 1974, p. 15.

[69] Republic of the Philippines, National Manpower and Youth Council, 1974-75 Fiscal Year Report, p. 14.

Other Scientific Societies and Science Education

The problem of updating the education and training of members has likewise been discussed by other scientific societies. Of particular concern to these has been the question of relevance of the structure of their education and training to Philippine conditions. These discussions have become more prominent since the late 1960s and have continued well into the present. The question of relevance of scientific education and training has been brought to the forefront by the increasing emigration of physicians, engineers and scientists from the Philippines to the more developed countries. In 1967, for example, the annual conference to celebrate National Science and Technology Week sponsored by the National Science Development Board on 10-16 July 1967 was on "Science and Public Policy." The conference was attended by scientists, engineers and physicians in government, the universities and colleges, and representatives of professional societies. Some of the papers discussed were: "Policies on Scientific Education and the 'Brain Drain,'" "Higher Education, An Appraisal," and papers reviewing the progress of physics, chemistry, mathematics and biology in the Philippines.[70] Discussions following the reading of these papers revealed a general consensus for the need to review the country's science and education policies and to relate these to policies in other sectors -- agriculture, health, industrial development and the like.

In 1970, the question of relevance of the structure for the education and training of scientists and engineers was highlighted by the results

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[70] Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967 (Manila: National Science and Development Board, 1968), pp. 257-263 ; 303-334.

of the study of the Presidential Commission to Survey Philippine Education. The Commission's findings focussed on the lopsided educational system which led to wastage of educated manpower in certain fields and shortages of highly trained manpower in other fields, notably the sciences and engineering. Increasing government concern with the country's manpower and human resources for economic development has given impetus to more discussions about the relevance of higher education in science and engineering to local conditions.

The Philippine Association for the Advancement of Science (PhilAAS), conducted a two-day symposium in 1970 on the topic "Critique of Our Present Scientific and Technological Education." It was attended by scientists, engineers, physicians, educators, government officials and representatives of industry. Papers were presented on agricultural education, engineering, medicine and the sciences. A recurrent theme in the discussions was the problem of adhering to international standards of scientific education and professional competence and making these relevant to the Philippine situation. The paper on agricultural education showed that the Western approach to analyzing agricultural and rural development was still pervasive in the country. The paper on medical education admitted that the medical curriculum in the country was still highly American-oriented. In the field of engineering, a problem that was discussed was the lack of exposure of engineering graduates to practical applications of their training to industry and other activities.[71]

In the 1974 Conference on National Science and Technology Week, sponsored by the National Science Development Board, a paper was read on

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[71] Paulo C. Campos and Jose R. Velasco, eds. Proceedings of the Philippine Association for the Advancement of Science, 1970 (Quezon City: Capitol Publishing House, Inc., 1970), especially pp. 137-183.

"The Education of Scientists and Technologists and National Development." Discussing the problem of external migration as well as internal brain drain (i.e. from rural areas to urban centers) of academic and scientific manpower, the paper drew attention to the need to relate science education and training to present and future needs of the various sectors of the economy.[72] In the same year, the Society for the Advancement of Research (SAR), a multidisciplinary organization dedicated to the promotion of scientific research,[73] convened a conference on the scientific and technological manpower component of national development. The symposium was attended by scientists in academic and government circles, government officials and administrators, representatives of agriculture, industry and the professional societies. The papers discussed included such topics as "Health Manpower Requirements for National Development," Scientific and Technological Manpower Component in the Food and Agriculture Sciences,"

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[72] Estela L. Zamora, "The Education of Scientists and Technologists and National Development," in Papers and Proceedings of the Conference on National Science and Technology Week, 15-21 July 1974 (Manila: National Science Development Board, 1975), pp. 1-10.

[73] SAR is made up of scientists most of whom are faculty members of the University of the Philippines at Los Baños. The bulk of its activities centers on assisting the Science Foundation of the Philippines (SFP) in implementing its Youth Research Apprenticeship Program (YRAP). The Program involves the training of selected high school students, science teachers and science club advisers in the methods of scientific research. YRAP participants are brought to the U.P.L.B. campus during the summer to enable them to use the university's research facilities. SAR members act as resource speakers and advisers at the YRAP, guiding students in the formulation of research proposals on problems relevant to their respective communities. These proposals become the basis of subsequent research projects by the participants, the results of which are presented at the annual National Science Fair organized by SFP. Prizes are awarded at these fairs to the three best research papers. From interview with Dr. Vicente G. Momongan, President of SAR, U.P. at Los Baños, 19 July 1977.

"The Role of High Level Manpower in the Physical and Mathematical Sciences," "The Scientific and Technological Manpower in the Engineering Sciences," and "Manpower Needs in the Biological Sciences."[74]

The discussion that followed the reading of papers were on the same themes that had been tackled in the previous conferences that had been sponsored by the NSDB and the PhilAAS. These are the continuing problems of how to attract more students to take up careers in engineering and the sciences, how to make the curricula in these fields more relevant, how to ensure quality education and how to retain highly-trained manpower in the country. There were also discussions of what policies could be adopted by the government along these lines.

Professional and Scientific Organizations in Science Policy Formulation

As can be seen from the above, professional associations and scientific societies are organized vertically, along disciplinary, specialized interests. The goals and activities of professional associations have centered on self-regulation that is, maintaining standards of professional education, controlling entry into the profession (the supply of practitioners), protecting the economic interests of members (job opportunities, schedule of professional fees, and so on), and promoting continuing professional education. Their involvement in government policy-making has been primarily confined to professional licensing and regulation and relevant legislation such as, for example, among engineering associations, the

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[74] Science Forum 1974 on National Development: Its Scientific and Technological Manpower Component, Papers and Proceedings (Los Baños, Laguna: Society for the Advancement of Research, Inc., April 1974).

National Building Code, and for the PMA, the Medicare Law.[75]

Similarly, scientific societies have been concerned with the promotion of their specific disciplinary interests. As such, the professional associations and scientific societies have been largely involved with aspects of science policy that directly touch on their particular interests rather than with a comprehensive program for the development of science in the Philippines. Where a professional association had perceived advantages in the promotion of a particular science policy, it has initiated and actively worked for the enactment of relevant legislation. This is illustrated, for example, by the role played by the Philippine Society of Sanitary Engineers (PSSE) in drafting the country's pollution control legislation and helping to secure its passage by Congress in 1964.[76] By this means, the PSSE was able to ensure professional representation in the National Pollution Control Commission and assure its continuing participation in the formulation of pollution control policy and regulations.[77]

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[75] The PMA also endorsed to the Philippine Senate in 1953, the enactment of an Act to regulate the practice of sanitary engineering along with 15 other Acts dealing with such matters as the establishment of regional health laboratories, additional government hospitals, and others. Journal of the Philippine Medical Association, Vol. XXIX, No. 10 (October 1953), p. 575.

[76] Republic Act No. 3931, "An Act Creating the National Water and Air Pollution Control Commission," 18 June 1964. See also Reynaldo M. Lesaca, "Pollution Control Legislation and Experience in a Developing Country," Journal of Developing Areas, Vol. 8, No. 4 (July 1974), pp. 544-547.

[77] Presidential Decree No. 984, 18 August 1976, amended Republic Act No. 3931 and replaced the National Water and Air pollution Control Commission with the National Pollution Control Commission. Sec. 3 of the Decree provides that the NPCC shall be composed of a full-time commissioner and two full-time deputy commissioners, one of whom shall "preferably be a sanitary engineer."

The behavior and role of Philippine professional associations and scientific societies in the formulation of science policy and other legislation tend to support similar observations made about scientists in American, British and Canadian politics.[78] Studies have pointed out that the specialist, technical training of scientists and engineers and their traditionally vertical, inward-looking organizations make them ill-equipped to act as interest groups that would work for broader issues of national science policy.

Most of the important legislation on science policy in the Philippines has been initiated if not influenced greatly by the PhilAAS. For example, PhilAAS in 1951 initiated the annual proclamation and celebration of National Science (now Science and Technology) Week by the President of the Philippines. The enactment of Republic Act No. 2067 in 1958, creating the National Science Development Board, and Republic Act No. 3361 in 1963, creating the Philippine Science High School, originated in PhilAAS-sponsored conventions and resolutions.[79] The annual conventions of PhilAAS have served as forums for the discussion of broader aspects of science policy such as, for example, "Rural Improvement Through Scientific Research," (1954); "Science and Technology in the Socio-Economic Program of the Philippines,"

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[78] Wallace S. Sayre, "Scientists and American Science Policy," in Robert Gilpin and Christopher Wright, eds., Scientists and National Policy-Making (New York and London: Columbia University Press, 1964), pp. 97-112; Robert C. Wood, "Scientists and Politics: The Rise of an Apolitical Elite," in Ibid., pp. 41-72; Norman J. Vig, Science and Technology in British Politics (Oxford/London: Pergamon Press, 1968), pp. 125-136; Margot Wojciechowski and J.W. Grove, "Looking Outward: The Changing Role of Scientific Societies," Science Forum, Vol.5, No. 3 (June 1972), pp. 29-31; Management Committee of SCITEC and Allen S. West, National Engineering, Scientific and Technological Societies of Canada; Science Council of Canada, Special Study No. 25 (Ottawa: December 1972), pp. 8-14,65-88.

[79] PhilAAS, 25th Anniversay Convention Program, op. cit., pp. 18-21.

(1962); "Industrialization Through Science and Technology," (1965); "Critique of Our Present Scientific and Technological Education," (1970); and "The Role of the Science Community in Policy-Making," (1975).

The effectiveness of PhilAAS in influencing government policy for science may be attributed not only to its multidisciplinary, broad-based membership, but also to the fact that its leadership has traditionally come from government science agencies such as, for instance, the Department of Health, the Department of Agriculture and Natural Resources, the National Institute of Science and Technology and later, the National Science Development Board. During its initial years of existence, the PhilAAS President also served as member of the national government's Science Advisory Committee.[80] At the same time, PhilAAS leaders have also been active members or officers of their respective professional societies. This overlapping membership in professional and scientific societies provide linkages and thus facilitate communications between specialized and generalist functional organizations like PhilAAS.[81]

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[80]Since the creation of the NSDB in 1958, the NSDB Chairman has become the government's official scientific adviser.

[81]For instance, PhilAAS' first president in 1951-53 was then serving his term as Secretary of Health and president of the Philippine Medical Association; the president in 1966-67 was also Vice Chairman and Executive Director of NSDB as well as an active member of engineering associations; the vice president for Division E (Geography and Earth Sciences) in 1975-77 was then incumbent Vice Chairman and Executive Director of the NSDB and past president (1973-74) of the Philippine Society of Civil Engineers; the president in 1976 was incumbent Commissioner of the National Institute of Science and Technology and Vice President of the Chemical Society of the Philippines. This overlapping leadership/membership has produced a situation which Dr. Allen West also observed in Canada and called the "same old faces" syndrome in scientific symposia and conferences. See Management Committee of SCITEC and West, op. cit., p. 81.

From available information, it appears that the functional interest groups rather than the purely scientific or professional associations have been more active participants in policy discussions on the general problems of science. For example, in the 1963 Senate Committee hearings on the problems of science, only the Philippine Medical Association and its component Manila Medical Association had representatives who presented their views. The other listed "association" witnesses were actually spokesmen for such economic interest groups as the Philippine Chamber of Industries, the Chamber of Agriculture and Natural Resources and the Producers and Exporters Associations.[82] Most of the participants at these hearings were government scientists representing a variety of agencies and offices and university/college presidents who acted as "surrogates" for scientists and engineers.[83] In the 1976 seminar-workshop to discuss government policy on pest control, it was the Pest Control Council which actively participated in drafting a pesticide control law.[84]

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[82] Republic of the Philippines, Congress, Senate, Committee on Scientific Advancement, Report on the Problems of Science in the Philippines (Manila: National Science Development Board, 1963).

[83] The term quoted was used by Sayre in op. cit., p. 101.

[84] The Pest Control Council is composed of five representatives each from three scientific societies -- the Phytopathological Society, the Weed Science Society and the Philippine Association of Entomologists, and two business organizations -- the Agricultural Pesticide Industry of the Philippines and the Pest Control Association of the Philippines. Interview with Dr. Dante Benigno, past president of the Philippine Phytopathological Society, University of the Philippines at Los Baños, 26 July 1977.

Summary and Conclusion

What emerges from this examination of the professional, scientific and engineering societies is their varying influence in the education and training of members and the formulation of national science policy. Except in the field of medical education, there has been no attempt so far by these organizations to radically restructure the existing curricula for science and engineering education. The success of the Philippine Medical Association in exercising a strong influence over the education and training of members can be attributed to its being the country's longest established professional organization, the prestige of the medical profession, and its ability to mobilize a unified and large membership to back up its programs and policy proposals. It has permanent headquarters and office staff, financial resources from membership dues and can also count on outside assistance to carry out its programs like support from pharmaceutical firms, foundations, and others. Its leadership comes from members who have been exposed to a variety of professional, managerial and scientific experience. Many members occupy high positions in government, particularly the Department of Health. It has representatives in the Board of Medical Education, and controls the membership of its Board of Medical Examiners who can, therefore, help enlist support for PMA-sponsored policy proposals.

Other scientific and engineering societies have not been as influential as PMA because of the existence of rival organizations that have divided their members in the past. It is only recently, through the leadership of the Professional Regulation Commission, that they have been forced to integrate their organizations. Most of these societies do not have permanent headquarters or staff. Their offices shift to the professional offices of those who serve as presidents. Because of these weaknesses, they have not been able to establish effective linkages, as has the PMA, with their examining boards, the government (specifically the Department of Education and Culture), and with the colleges and universities. These linkages would enable them to have better feedback and probably more influence on the direction of the education and training of members. In the past, there have been complaints that the examining boards of these professions had practically dictated curricula by their decisions over topics and the weights that they assign to these in the licensing examinations. Decisions had often been made by the examining boards without consulting the appropriate professional schools and colleges which offer the requisite degrees.[85] Many private colleges have, therefore, responded to this situation by simply training students to pass the board examinations. Thus there is widespread dissatisfaction with the quality of graduates from these programs among prospective employers in industry, government, and educational institutions. The case of engineering graduates has been mentioned by the Vocational-Technical Education Special Area Group of the Presidential Commission to Survey Philippine Education.[86]

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[85] The Board of Examiners for Chemistry was specifically mentioned in Republic of the Philippines, Congress, Senate, Committee on Education, Higher Education Research Council, Higher Education in the Philippines in 1970-71 (Manila: 1972, mimeo.), Vol. I, pp. 269-270, 278.

[86] In the study done in 1969 on some 116 industrial firms, the majority of the firms rated as only fair the capabilities of Filipinos with engineering degrees to inspect, trouble-shoot, cost and maintain equipment. A similar assessment was made on their capabilities to oversee production, with respect to quality, systems controls, data processing, and the like. The respondent firms pointed out that their performance could only be improved after six months of on-the-job training provided by the employers. See Presidential Commission to Survey Philippine Education, Special Area Group for Vocational-Technical Education, Vocational-Technical Education in the Philippines (Quezon City: National Manpower and Youth Council,1974),pp.27, 135-139.

The recent changes in the structure of professional regulation -- the creation of the PRC, the integration of professional organizations and the increased activity of these groups are indicative of the growing trend towards greater professionalization of the sciences and engineering in the country. The growth and development of the scientific and engineering professions have been greatly aided by the increasing attention given by the government to the role of science and technology in development programs and the improvement of professional education and training. This is evident from the creation of science agencies such as the NSDB and the NPCC which was mentioned above and further discussed in Chapter VI. It can also be seen in the government's initiative in strengthening engineering education through the EDPITAF Engineering Education Project. The expansion of government programs and functions such as, for instance, Medicare, the growth of state-supported colleges and universities discussed in Chapter III, and the gradual modernization of the economy mentioned in Chapter I, have undoubtedly resulted in increased employment opportunities for scientists and engineers. Over the years, the professional and scientific community has thus grown.

With their increasing strength and stability, professional associations and scientific societies have begun to examine their social roles in the context of the government's national development programs. Hence, the concern with the relevance of education and training of members in recent years. The government's preoccupation with policies to grant further recognition of the important role of scientists and engineers in national development may stimulate further interest among these groups in science policy and other public issues.[87] Given the existing structure of scientific and professional organizations, however, their contribution to science policy may continue to be restricted to narrow disciplinary interests. This can be expected since science policy formulation and its effective implementation necessitate continuing assessment of the interrelationships between science and technology and socioeconomic conditions. As such, these associations can at best provide professional advice and criticism on particular or sectoral aspects of policy. There is, therefore, a need for them to develop the ability to perceive and analyze the interconnections between scientific and technological progress and social change in the Philippine situation.[88] This can be done, for instance, by having common headquarters for the secretariats of all scientific and professional associations, such as that proposed by the NSDB in 1973-75.[89]

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[87] Presidential Decree No.997,"conferring civil service eligibility on scientific and technological specialists in recognition of their dedication and contribution to the development program of the country," was issued on 16 September 1976; Presidential Decree No.1003-A,creating the National Academy of Science and Technology was issued on 22 September 1976. See "RP Science Development," Bulletin Today, 31 December 1976, p. 10; "To Grant Eligibility to Filipino Scientists," Bulletin Today, 1 January 1977, p. 17.

[88] A similar view was expressed by B.V. Rangarao, "Science Policy: Role of Academic Societies," Science and Culture, Vol. 43, No. 5 (1977), p. 200.

[89] This was the Center for Scientific and Technological Organizations project. Interview with Mr. Silvestre Javier, CSTO Project Director and Chief, International Relations Division, NSDB, Metro Manila, 20 July 1977. A similar proposal was made in Canada by the Management Committee of SCITEC. See Management Committee of SCITEC and West, op. cit., pp. 11-12.

It is apparent from this chapter that very little has actually been written about the professional and scientific associations in the Philippines. There is thus a need for more systematic, empirical studies on the nature of these organizations, their social and political roles, their reciprocal relations with government, on one hand, and with the universities and colleges, on the other. It remains to be seen whether the trends observed in this study will continue, that is, whether the professional societies will indeed exercise greater influence over the education and training of members and related policies, and whether this will be mutually beneficial to the professional and scientific community and the broader society of which they form part.

The next chapter will look into the employment of scientists and engineers in the Philippines, the institutions where they are found and the functions that they perform.

Chapter V

Employment of Scientists and Engineers

At the beginning of this study we looked at the socioeconomic environment of Philippine science and the goals of the government to put into perspective the possible roles of scientists and engineers in the country's development. In the two preceding chapters, we noted how the educational system and the professional organizations produce qualified scientists and engineers and thus determine the supply of this type of manpower. We will now analyze the employment of these persons and the functions that they perform. Based on this information, one may examine the trends in the demand for scientific and engineering personnel.

Distribution of Scientists and Engineers

There has been no comprehensive up-to-date inventory of scientific and engineering personnel in the country since the National Science Development Board (NSDB) undertook studies of scientists in the national government (1965), private industry (1965), educational institutions and nonprofit organizations (1967-68), and local governments (1968). These were undertaken with the help of the Philippine Statistical Association and the University of the Philippines Statistical Center. The studies were done by sample survey of institutions and individual employers.

The surveys showed that there were 86,757 scientists and engineers. Of this number, 12.9 per cent were employed by the national government, 5.1 per cent by local governments, 68.1 per cent by private industry, and the remainder were in educational institutions and nonprofit organizations. Table V-1 summarizes the distribution of scientific and technological manpower in the Philippines by field of main activity[1] and sector of employment in 1965-1968.

It can be seen from the table that the national government employed more than half (53.1 per cent) of the agricultural scientists. Almost half (48.9 per cent) of those in the earth sciences were also in the national government.

The bulk of the scientists employed by local governments (2,219 or 49.7 per cent of sector total) were in the medical sciences. Those in engineering made up 13.9 per cent of sector total, while those in agricultural sciences comprised 9.3 per cent.

Private industry employed more than four fifths (89.6 per cent) of engineers covered by the surveys, with more than half of them working in manufacturing establishments. Over four fifths (85.5 per cent) of the chemists were also found in private industry as were more than half (57 per cent) of those in physics and astronomy. Chemists were employed mainly in manufacturing enterprises while physicists and astronomers were in the transportation industry.

Educational institutions employed three quarters (74.8 per cent) of the biological scientists. The biggest number (87.9 per cent) of scientists in educational institutions were solely engaged in teaching. Very few worked exclusively in research or combined teaching and research.

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[1]The surveys defined field of main activity as the line of work in which a scientist spends the largest part of his working time in the job. Scientists and engineers were defined as "all persons with at least a Bachelor's degree in a specific academic specialty in any of the physical, natural, mathematical, social sciences or engineering or other professionals engaged in engineering or scientific work.... They do not include persons trained in the sciences or engineering but currently employed in positions not requiring such training." See Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. I, The Report (Manila: National Science Development Board-Philippine Statistical Association, Inc., 1966, mimeo.),pp. 11-12.

Table V-1*
Distribution of Scientific and Technological Manpower by Main Activity and Sector Employment, 1965-1968

Field of Main Activity	Sector of Employment					
	Philippines, Total		National Government		Local Governments	
	Number	%	Number	%	Number	%
Engineering	45,133	52.0	2,789	6.2	621	1.4
Medical Sciences	10,047	11.6	1,401	13.9	2,219	22.1
Agricultural Sciences	6,343	7.3	3,373	53.1	368	5.8
Biological Sciences	1,791	2.1	196	10.9	136	7.6
Earth Sciences	893	1.0	437	48.9	10	1.1
Physics and Astronomy	1,230	1.4	41	3.3	56	4.6
Chemistry	8,267	9.5	335	4.0	43	0.5
Mathematics	3,176	3.7	680	21.4	351	11.1
Social Sciences	5,970	6.9	1,643	27.5	569	9.5
Others	3,907	4.5	299	7.7	89	2.3
Total	86,757	100.0	11,194	100.0	4,462	100.0
Per Cent Distribution		100.0		12.9		5.1

Sources of Data: Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. I, The Report (Manila: National Science Development Board-Philippine Statistical Association, Inc., 1966, mimeo.), Table A-17; Survey of Scientific and Technological Manpower in the Philippines: Local Government, Vol. II, Statistical Tables (Manila: National Science Development Board, 1969, mimeo.), Tables 1, 7 & 12; University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Private Industry, Vol. II, Statistical Tables (Manila: National Science Development Board-University of the Philippines Statistical Center, 1967, mimeo.), Table A-4; University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations, Vol. II, Statistical Tables (Manila: National Science Development Board-University of the Philippines Statistical Center, 1968, mimeo.), Tables A-11 & A-12.

Details may not add up to totals due to rounding.

*Table is continued next page.

Table V-1 (continued)
Distribution of Scientific and Technological Manpower By Main Activity and Sector Employment, 1965-1968

Field of Main Activity	Sector of Employment						Per Cent Total
	Private Industry		Educational Institutions		Nonprofit Organizations		
	Number	%	Number	%	Number	%	Distrib.
Engineering	40,419	89.6	1,244	2.8	60	0.1	100.0
Medical Sciences	4,038	40.2	2,064	20.5	325	3.2	100.0
Agricultural Sciences	1,972	31.1	555	8.7	75	1.2	100.0
Biological Sciences	87	4.9	1,340	74.8	32	1.8	100.0
Earth Sciences	299	33.5	144	16.1	3	0.3	100.0
Physics and Astronomy	701	57.0	428	34.8	4	0.3	100.0
Chemistry	7,072	85.5	815	9.9	2	nil	100.0
Mathematics	1,048	33.0	1,085	34.2	12	0.4	100.0
Social Sciences	232	3.9	3,432	57.5	94	1.6	100.0
Others	3,291	84.2	217	5.6	11	0.3	100.0
Total	59,159	100.0	11,324	100.0	618	100.0	100.0
Per Cent Distribution		68.1		13.1		0.7	

Most of the scientists and engineers in all sectors finished only the Bachelor's degree. Very few had the Ph.D.

An examination of survey results by sector gives more insights into the employment of scientists and engineers.

Scientists and Engineers in Government

There were actually two surveys made of scientific and technological personnel in the national government in 1965. The first survey was done by interviewing personnel officers of government agencies. This showed that there were 11,194 scientists and engineers employed in national agencies. Distributed according to their field of main activity, as shown in Table V-1, the bulk of these were in the agricultural sciences (3,373 or 30.1 per cent of sector total) and engineering (2,789 or 24.9 per cent). Only 41 (0.4 per cent) were in physics and astronomy; 196 (2 per cent) were in the biological sciences; and 355 (3 per cent) were in chemistry.

Most of those in the agricultural sciences worked in the Department of Agriculture and Natural Resources. Over half (58 per cent) of those in engineering were employed in the Department of Public Works and Communications; less than a fifth (19 per cent) were in government-owned enterprises, chiefly the National Power Corporation.[2]

According to educational attainment, by far the biggest number (90.1 per cent) of scientists and engineers in the national government were Bachelor's degree holders. Few (2.3 per cent) had Master's degrees; fewer still (0.3 per cent) were Ph.D. holders. This can be seen from Table V-2.

To get more details on the national government's scientific and technological manpower, a second survey was made. This was done by questionnaires sent to a sample of employees in each government office randomly chosen. The questionnaire returns showed a total of 9,589 scientists and engineers (8.6 per cent) out of 111,034 employees working in the national government. Technicians comprised 10.2 per cent (11,356) of the total number of employees. It will be noted that the number of scientists who responded to the questionnaires was smaller (88.1 per cent) than the number employed by the national government as shown in Table V-1.

Based on the results of the questionnaire survey, it was found that a quarter of scientists and engineers were in the Executive Department, i.e. the Office of the President and a variety of agencies attached to it. Among the latter, the principal employers of scientists and

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[2] Ibid., p. 21.

Table V-2
Distribution of Scientists and Engineers by Main Activity and Educational Attainment, National Government, 1965

Field of Main Activity	Educational Attainment					
	Bachelor's Degree	Master's Degree	Professional & Medical Degree	Ph.D.	Others	Total
Engineering	2,754	28	2	3	2	2,789
Mathematics	634	35	7	3	1	680
Agricultural Sciences	3,339	21	11	2	-	3,373
Biological Sciences	148	12	30	4	2	196
Medical Sciences	641	35	668	5	52	1,401
Earth Sciences	423	11	-	2	1	437
Physics and Astronomy	34	4	1	2	-	41
Chemistry	305	20	1	8	1	335
Social Sciences	1,526	84	27	5	1	1,643
Others	286	11	1	1	-	299
Total	10,090	261	748	35	60	11,194
Per Cent Distribution	90.1	2.3	6.7	0.3	0.5	100.0

Source of Data: Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. I, The Report (Manila: National Science Development Board-Philippine Statistical Association, Inc., 1966, mimeo.), p. 22.

Details may not add up to totals due to rounding.

engineers were the Agricultural Productivity Commission (APC),[3] Abaca Development Board, Philippine Virginia Tobacco Administration (PVTA), and National Water and Air Pollution Control Commission (NWAPCC).[4]

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[3]The APC was later renamed Bureau of Agricultural Extension and is now part of the Department of Agriculture.

[4]The NWAPCC became the National Pollution Control Commission and was transferred to the National Science Development Board in 1973. It was reorganized in 1976 (by virtue of Presidential Decree No. 984, 18 August 1976) and returned to the Office of the President. It is presently under the Department of Human Settlements as a result of Presidential Decree No. 1396 (2 June 1978).

Scientists in the Agricultural Productivity Commission were principally performing extension work like the dissemination of research results and their application. Those in the Abaca Development Board were engaged in research on abaca (Manila hemp) in cooperation with the Bureau of Plant Industry and the Abaca Corporation of the Philippines. Similarly, scientists in the PVTA did research and extension work to improve the quality and increase production of Virginia tobacco. Those employed in the NWAPCC were engaged in research on pollution and regulatory functions related to pollution control.

The Department of Public Works and Communications employed over a fifth (21.4 per cent) of scientists in the national government, most of whom were in engineering work. They were in such agencies as the Bureau of Public Works, Bureau of Posts, Bureau of Public Highways and others. The Department of Agriculture and Natural Resources (DANR)[5] had 16.3 per cent of scientists and engineers. Most of these performed research, extension and exploration work in the Bureau of Animal Industry, Forestry, Mines, Plant Industry, and Soils, and the Philippine Fisheries Commission.

Some 10.9 per cent of scientists and engineers were found in government enterprises of which the National Power Corporation had the most (400 or 4.2 per cent of national government total), followed by the Philippine Sugar Institute (200 or 2.1 per cent of national total). The Department of Health employed 6.9 per cent of scientists, most of whom were in the medical and biological sciences. They were in the Bureau of Disease Control, Bureau of Hospitals, Bureau of Research and

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[5]The DANR was split into the Department of Agriculture and Department of Natural Resources by Presidential Decree No. 461 (17 May 1974).

Laboratories and the Bureau of Dental Health Services. The National Science Development Board (which at that time included the National Institute of Science and Technology and Philippine Atomic Energy Commission) had 3.2 per cent of scientists and engineers. They were engaged in research and development, management and administration. Table V-3 shows the distribution of scientists and engineers in the national government as of June 1965.

Table V-3
Distribution of Scientists and Engineers
National Government, by Department/Agency, June 1965

Department/Office	Number	Per Cent
Legislative Department	16	0.2
Executive Department	2,472	25.8
Department of Foreign Affairs	12	0.1
Department of Finance	103	1.1
Department of Justice	265	2.8
Department of Agriculture and Natural Resources	1,561	16.3
Department of Public Works and Communications	2,051	21.4
Department of Education	22	0.2
Department of Labor	58	0.6
Department of National Defense	516	5.4
Department of Health	665	6.9
Department of Commerce and Industry	338	3.5
Department of General Services	6	0.1
Office of Economic Coordination	8	0.1
National Science Development Board	310	3.2
Government Auditing Office	4	nil
Government-owned enterprises	1,043	10.9
Government Banks	139	1.4
Total	9,589	100.0

Source of Data: Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. III, Statistical Tables (Manila: National Science Development Board-Philippine Statistical Association, Inc., 1966, mimeo.),pp. 438-481.

Looking at the positions they occupied, over three fifths (64 per cent) of scientists and engineers in the national government were in the professional category. Over a third (34.1 per cent) were in managerial positions. The rest were in transportation and communication and other positions.[6]

According to their field of specialization in education, about two fifths (39 per cent) of scientists and engineers were in engineering, over a fourth (26.5 per cent) were in the agricultural sciences and 15.1 per cent were in the medical sciences. Very few (2.6 per cent) specialized in the earth sciences; fewer still (1.5 per cent) were in mathematics.[7]

Examining the most important function scientists and engineers were performing in the national government, slightly less than a third (32.7 per cent) were in research and development; 16.7 per cent were in management and administration; 12.8 per cent were in sales and service; 12.7 per cent were in production and operation; and 2.1 per cent were in exploration. Relating the most important function that they performed with their field of specialization, slightly less than a third (32.6 per cent) of those in research and development were in engineering; over a fifth (23.3 per cent) were in the agricultural sciences; 13.5 per cent were in the medical sciences; and 11.8 per cent were in chemistry. Among those in management and administration, over two fifths (43 per cent) had specialized in engineering; over a fifth (23.7

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[6]Philippine Statistical Association, Inc., op. cit., Vol. I, p. 32.

[7]There were no scientists in physics and astronomy covered by the questionnaire survey. Those who did the study explained that this was possible because of the small number who had specialized in these fields. See ibid., p. 37.

per cent) were in the agricultural sciences; and less than a fifth (18.3 per cent) were in the medical sciences.

More than half (58.5 per cent) of scientists performing sales and service functions had specialized in agricultural sciences; about a fourth (24.5 per cent) were in engineering; and the rest were in the medical and biological sciences.

Two thirds (66.7 per cent) of scientists in production and operations had specialized in engineering; 15.8 per cent were in the agricultural sciences; and 7.8 per cent had specialized in chemistry. Table V-4 shows the distribution of scientists and engineers in the national government by field of specialization in education and the most important function that they performed.

Of the 4,462 scientific personnel working in local governments, about half (49.7 per cent) were in the medical sciences. About a quarter of those in the medical sciences (557) were physicians and surgeons working as provincial, city or municipal health officers. They were appointed and supervised by the national Department of Health even though local governments contributed substantially to their upkeep. The rest were dentists, pharmacists, and others.

The remainder of scientific personnel in local governments were in engineering (13.9 per cent), most of whom were civil engineers. Those in the agricultural sciences made up 9.3 per cent, while those in mathematics comprised 7.9 per cent, as seen from Table V-1. These scientists and engineers held such local positions as highway-district or city engineers, provincial or city agriculturists, provincial, city or municipal treasurers and assessors, city planners, city fire department chiefs and others. Their functions included management and administration, applied research, extension services, production and operations.

Table V-4
Distribution of Scientists and Engineers
National Government, by Specialization and Function, June 1965

Field of Specialization	Most Important Function							
	Overall Total		Research & Development		Management & Admin.		Other than Research	
	No.	%	No.	&	No.	%	No.	%
Engineering	3,740	39.0	1,024	32.6	688	43.0	255	38.2
Mathematics	146	1.5	66	2.1	25	1.6	3	0.5
Agricultural Sciences	2,539	26.5	733	23.3	378	23.7	150	22.5
Biological Sciences	455	4.7	172	5.5	90	5.6	33	5.0
Medical Sciences	1,443	15.1	423	13.5	292	18.3	155	23.2
Earth Sciences	252	2.6	50	1.6	10	0.6	49	7.4
Chemistry	561	5.9	371	11.8	40	2.5	5	0.8
Social Sciences	398	4.2	291	9.3	40	2.5	14	2.1
Other Science Fields	10	0.1	-	-	10	0.6	-	-
Not reported	45	0.5	10	0.3	25	1.6	3	0.5
Total	9,589	100.0	3,140	100.0	1,598	100.0	667	100.0
Per Cent Distribution		100.0		32.7		16.7		7.0

Field of Specialization	Most Important Function							
	Sales & Service		Production & Operation		Exploration		Others	
	No.	%	No.	%	No.	%	No.	%
Engineering	301	24.5	810	66.7	82	40.0	580	37.8
Mathematics	-	-	30	2.8	-	-	22	1.4
Agricultural Sciences	720	58.5	192	15.8	63	30.7	303	19.8
Biological Sciences	120	9.7	5	0.4	-	-	35	2.3
Medical Sciences	85	6.9	55	4.5	-	-	433	28.2
Earth Sciences	-	-	23	1.9	60	29.3	60	3.9
Chemistry	-	-	95	7.8	-	-	50	3.3
Social Sciences	3	0.2	-	-	-	-	50	3.3
Other Science Fields	-	-	-	-	-	-	-	-
Not reported	2	0.2	5	0.4	-	-	-	-
Total	1,231	100.0	1,215	100.0	205	100.0	1,533	100.0
Per Cent Distribution		12.8		12.7		2.1		16.0

Source of Data: Philippine Statistical Association, Inc., Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, Vol. III, Statistical Tables (Manila: National Science Development Board-Philippine Statistical Association, Inc., 1966, mimeo.), pp. 840-841.

Details may not add up to totals due to rounding.

Scientists and Engineers in Private Industry

Private industry employed over half of the country's scientists and engineers. Results of the survey of scientific and technological personnel in this sector in 1965 showed that there were 59,159 (9.8 per cent) scientists and engineers, and 107,707 (18.1 per cent) technicians, out of 605,825 workers.

Distributed according to fields of main activity, over two thirds (68.3 per cent) of scientific and technological personnel were in engineering, 12 per cent were in chemistry, 6.8 per cent were in the medical sciences, and 3.3 per cent were in agricultural sciences. There were very few scientists in the biological sciences (0.1 per cent), earth sciences (0.5 per cent), and physics and astronomy (1.2 per cent).

More than half (51.3 per cent) of scientists and engineers in private industry had Bachelor's degrees. Two fifths (39.9 per cent) had professional degrees. Only a few had Master's or Ph.D. degrees. It is interesting to note that thrice as many Ph.D.s were in engineering as there were in the agricultural sciences. This can be seen from Table V-5. It is apparent from the table that scientists and engineers in private industry possessed relatively higher educational qualifications (in absolute numbers as well as proportionately) than those in the national government.

Looking at the employment of scientists and engineers according to type of industry, almost two thirds were in manufacturing establishments, 10 per cent were in commerce, 7.2 per cent were in the transportation business, 5.9 per cent in construction, and 4.8 per cent were in agriculture. Of those in manufacturing, over two thirds (26,593 or 69.7 per cent) were in engineering. This group also accounted for 65.8

Table V-5
Distribution of Scientists and Engineers
Private Industry, by Main Activity and Educational Attainment, 1965

Field of Main Activity	Educational Attainment					
	Bachelor's Degree	Master's Degree	Professional & Medical Degree	Ph.D.	Others	Total
Engineering	19,808	797	18,565	300	949	40,419
Mathematics	532	6	110	-	400	1,048
Agricultural Sciences	1,771	50	50	100	1	1,972
Biological Sciences	84	-	2	-	1	87
Medical Sciences	2,268	109	1,296	2	363	4,038
Earth Sciences	283	-	16	-	-	299
Physics and Astronomy	101	600	-	-	-	701
Chemistry	2,928	8	3,172	52	912	7,072
Social Sciences	124	2	105	1	-	232
Others	2,424	200	306	-	361	3,291
Total	30,323	1,772	23,622	455	2,987	59,159
Per Cent Distribution	51.3	3.0	39.9	0.8	5.0	100.0

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Private Industry, Vol. II, Statistical Tables (Manila: National Science Development Board-U.P. Statistical Center, 1967, mimeo.),Table A-10.

per cent of all those in engineering for all industries. Over four fifths of those in chemistry (95.5 per cent) were likewise employed in manufacturing as were almost three quarters (74.5 per cent) of those in the medical sciences.[8]

Among those in physics and astronomy, over four fifths (85.6 per cent) were employed in the transportation industry. Sixty-one per cent of those in mathematics were in commerce. Nearly all (98.8 per cent) of those in the biological sciences were in manufacturing. As could be expected, over four fifths of those in the agricultural sciences

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[8]Most of those included under medical sciences in the survey were in pharmacy (1,931) and optometry (800).

Table V-6
Distribution of Scientists and Engineers
Private Industry, by Main Activity and Industry, 1965

Field of Main Activity	Industry: Overall Total No.	%	Agriculture No.	%	Forestry & Logging No.	%	Mining No.	%	Manufacturing No.	%
Engineering	40,419	100.0	861	2.1	956	2.4	1,026	2.5	26,593	65.8
Mathematics	1,048	100.0	-	-	-	-	-	-	227	21.7
Agricultural Sciences	1,972	100.0	1,701	86.3	11	0.6	-	-	44	2.2
Biological Sciences	87	100.0	-	-	-	-	-	-	86	98.9
Medical Sciences	4,038	100.0	53	1.3	-	-	4	0.1	3,008	74.5
Earth Sciences	299	100.0	-	-	-	-	39	13.0	151	50.5
Physics and Astronomy	701	100.0	-	-	-	-	-	-	101	14.4
Chemistry	7,072	100.0	200	2.8	-	-	11	0.2	6,753	95.5
Social Sciences	232	100.0	1	0.4	-	-	-	-	19	8.2
Other Science Fields	3,291	100.0	1	nil	100	3.0	7	0.2	1,159	35.2
Total	59,159	100.0	2,817	-	1,067	-	1,087	-	38,141	-
Per Cent Distribution		100.0		4.8		1.8		1.8		64.5

Field of Main Activity	Industry: Construction No.	%	Utilities No.	%	Commerce No.	%	Transportation No.	%	Services No.	%	NEC* No.	%
Engineering	3,358	8.3	1,002	2.5	3,851	9.5	2,347	5.8	408	1.0	17	nil
Mathematics	50	4.8	-	-	644	61.5	107	10.2	20	1.9	-	-
Agricultural Sciences	-	-	-	-	216	10.9	-	-	-	-	-	-
Biological Sciences	-	-	-	-	-	-	1	1.1	-	-	-	-
Medical Sciences	-	-	-	-	305	7.6	16	0.4	652	16.1	-	-
Earth Sciences	50	16.7	1	0.3	1	0.3	-	-	57	19.1	-	-
Physics and Astronomy	-	-	-	-	-	-	600	85.6	-	-	-	-
Chemistry	-	-	-	-	105	1.5	-	-	3	nil	-	-
Social Sciences	-	-	3	1.3	4	1.7	205	88.4	-	-	-	-
Other Science Fields	-	-	-	-	771	23.4	953	29.0	300	9.1	-	-
Total	3,458	-	1,006	-	5,897	-	4,229	-	1,440	-	17	-
Per Cent Distribution		5.9		1.7		10.0		7.2		2.4		nil

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines; Private Industry, Vol. II, Statistical Tables (Manila: National Science Development Board-U.P. Statistical Center, 1967, mimeo.), Table A-4.

Details may not add up to totals due to rounding.

*Not Elsewhere Classified.

(86.3 per cent), were in agriculture; 10.9 were in commerce. Table V-6 shows the distribution of scientists and engineers in private industry by fields of main activity and industry.

In terms of geographical distribution, over two thirds (71 per cent) of scientists in agriculture and over four fifths (85.5 per cent) of those employed in construction were found in Manila. Ninety-five per cent of those in logging, two thirds (66.3 per cent) of those in the mining industry and over half (56.6 per cent) of those employed in manufacturing were in the provinces. This can be seen from Table V-7.

Table V-7
Distribution of Scientists and Engineers
Private Industry, by Kind and Location, 1965

Industry	Location					
	Manila		Provinces		Philippines	
	Number	%	Number	%	Number	%
Agriculture	2,000	8.1	817	2.4	2,817	4.8
Forestry and Logging	50	0.2	1,017	3.0	1,067	1.8
Mining	366	1.5	721	2.1	1,087	1.8
Manufacturing	16,664	67.1	21,477	62.5	38,141	64.5
Construction	2,958	11.9	500	1.5	3,458	5.9
Utilities	285	1.1	721	2.1	1,006	1.7
Commerce	1,778	7.2	4,119	12.0	5,897	10.0
Transportation	160	0.6	4,069	11.8	4,229	7.2
Services	540	2.2	900	2.6	1,440	2.4
Not Elsewhere Classified	17	0.1	--	-	17	nil
Total	24,818	100.0	34,341	100.0	59,159	100.0

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Private Industry, Vol. II, Statistical Tables (Manila: National Science Development Board-U.P. Statistical Center, 1967, mimeo.),Table A-3.

Details may not add up to totals due to rounding.

Looking at their field of main activity and geographical distribution, almost three quarters (74.1 per cent) of scientists in mathematics were in Manila. Over half of those in the agricultural sciences (63.3 per cent) and medical sciences (66.4 per cent) were likewise in Manila.

The overall distribution of scientists and engineers by field of main activity and geographic location was 42 per cent in Manila and 58 per cent in the provinces. This is shown in Table V-8.

Table V-8
Distribution of Scientists and Engineers
Private Industry, By Main Activity and Location, 1965

Field of Main Activity	Location						Per Cent Distrib.
	Manila		Provinces		Philippines		
	Number	%	Number	%	Number	%	
Engineering	17,257	42.7	23,162	57.3	40,419	100.0	68.3
Mathematics	446	42.6	602	57.4	1,048	100.0	1.8
Agricultural Sciences	1,346	68.3	626	31.7	1,972	100.0	3.3
Biological Sciences	87	100.0	-	-	87	100.0	0.2
Medical Sciences	2,682	66.4	1,356	33.6	4,038	100.0	6.8
Earth Sciences	277	92.6	22	7.4	299	100.0	0.5
Physics and Astronomy	1	0.1	700	99.9	701	100.0	1.2
Chemistry	2,432	34.4	4,640	65.6	7,072	100.0	12.0
Social Sciences	27	11.6	205	88.4	232	100.0	0.4
Other Science Fields	263	8.0	3,028	92.0	3,291	100.0	5.6
Total	24,818		34,341		59,159		100.0
Per Cent Distribution		42.0		58.0		100.0	

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Private Industry, Vol. II, Statistical Tables (Manila: National Science Development Board-U.P. Statistical Center, 1967, mimeo.), Table A-2.

Scientists and Engineers in Educational Institutions

The survey of scientific and technological manpower in universities and colleges was done in 1967-1968. In a sample of 147 universities and colleges all over the country, there were 11,324 scientists and engineers occupying academic positions.[9] Of this number, over four

[9]The survey actually found a total of 13,224 scientists and engineers or 49 per cent of a total of 27,000 academic personnel included in the sample. Of the 13,224 scientists, 1,900 reported that their field of main activity was not in line with their field of specialization. For purposes of this discussion, therefore, only those 11,324 scientists and engineers whose field of main activity was in line with their field of specialization will be considered. See University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations, Vol. I, The Report (Manila: National Science Development Board-U.P. Statistical Center, 1968, mimeo.), pp. 6-8, 19.

fifths (87.9 per cent) were engaged in teaching, 1.4 per cent were in research, 8.2 per cent combined teaching and research, and the rest were in extension and other services. One half (50.3 per cent) of these academic scientists were employed by colleges and universities in Manila. Table V-9 shows the distribution of scientists and engineers in educational institutions by function and location.

Table V-9
Distribution of Scientists and Engineers with Academic Positions Universities and Colleges, by Function and Location, 1968

Function	Location			
	Philippines		Manila	
	Number	Per Cent	Number	Per Cent
Teaching	9,951	87.9	4,670	82.0
Research	157	1.4	74	1.3
Teaching and Research	933	8.2	792	13.9
Extension Services	88	0.8	72	1.3
Others	195	1.7	87	1.5
Total	11,324	100.0	5,695	100.0
Manila as per cent of Philippine total ---- 50.3 per cent				

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations, Vol. I, The Report (Manila: National Science Development Board-U.P. Statistical Center, 1968, mimeo.), Tables 7 and 12, pp. 24, 31.

According to their area of specialization, almost one third (30.3 per cent) of scientists in educational institutions were in the social sciences. Less than a fifth (18.2 per cent) were in the medical sciences; 11.8 per cent were in the biological sciences; 11 per cent were in engineering; 9.6 per cent were in mathematics; and 7.2 per cent in chemistry. Earth sciences, physics and astronomy, and the agricultural sciences made up the smallest groups being 1.3 per cent, 3.8 per cent and 4.9 per cent respectively, of the total of all scientific fields.

According to field of main activity and function, over four fifths (87.9 per cent) of academic scientists were engaged in teaching. Only 8.2 per cent were engaged in both teaching and research, over a third of whom were in the medical sciences. Of those engaged exclusively in research, 30 per cent were in the biological sciences, 31 per cent were in the social sciences, and 10 per cent each in the agricultural sciences and chemistry. There was no one in physics and astronomy who reported doing research only. Among those who were engaged in extension services, 46.7 per cent were in the medical sciences and 31.8 per cent were in the agricultural sciences. Table V-10 shows the distribution of scientists and engineers by area of main activity and function.

There were 618 scientists out of 1,226 personnel surveyed in 28 nonprofit organizations. Over half of these(52.6 per cent) were in the medical sciences; 15.2 per cent were in the social sciences; 12.3 per cent were in the agricultural sciences; and 9.7 per cent were in engineering. Most of these scientists were engaged in training and extension services. Only about one per cent of these scientific personnel in nonprofit organizations had degrees beyond the Bachelor's level.[10]

<u>Trends in the Employment of Scientists and Engineers</u>

There have been no recent comprehensive studies done on the existing scientific and technological manpower in the country. It is certain, however, that the number of scientists and engineers employed in all sectors has increased considerably. Within the national government, growing employment opportunities have opened up for scientists and engineers as a result of the reorganization of the executive branch of the national government which took place in 1973. This resulted in the

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[10] *Ibid.*, pp. 82-83.

Table V-10
Distribution of Scientists and Engineers with Academic Positions Universities and Colleges, by Main Activity and Function, 1968

Field of Main Activity	Overall Total		Type of Function: Teaching		Research	
	Number	%	Number	%	Number	%
Engineering	1,244	11.0	1,203	12.1	10	6.4
Mathematics	1,085	9.6	1,042	10.5	6	3.8
Agricultural Sciences	555	4.9	395	4.0	16	10.2
Biological Sciences	1,340	11.8	1,045	10.5	47	30.0
Medical Sciences	2,064	18.2	1,608	16.1	11	7.0
Earth Sciences	144	1.3	124	1.2	1	0.6
Physics and Astronomy	428	3.8	387	3.9	-	-
Chemistry	815	7.2	684	6.9	17	10.8
Social Sciences	3,432	30.3	3,247	32.6	49	31.2
Other Science Fields	217	1.9	216	2.2	-	-
Total	11,324	100.0	9,951	100.0	157	100.0
Per Cent Distribution		100.0		87.9		1.4

Field of Main Activity	Type of Function: Teaching & Research		Extension		Others	
	Number	%	Number	%	Number	%
Engineering	21	2.2	-	-	10	5.1
Mathematics	23	2.5	2	2.3	12	6.1
Agricultural Sciences	94	10.1	28	31.8	22	11.3
Biological Sciences	177	19.0	15	17.0	56	28.8
Medical Sciences	349	37.5	41	46.7	55	28.2
Earth Sciences	18	1.9	-	-	1	0.5
Physics and Astronomy	40	4.3	-	-	1	0.5
Chemistry	105	11.2	1	1.1	8	4.1
Social Sciences	105	11.2	1	1.1	30	15.4
Other Science Fields	1	0.1	-	-	-	-
Total	933	100.0	88	100.0	195	100.0
Per Cent Distribution		8.2		0.8		1.7

Source of Data: University of the Philippines Statistical Center, Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations, Vol. II, Statistical Tables (Manila: National Science Development Board-U.P. Statistical Center, 1968, mimeo.), Tables A-11 and A-12.

Details may not add up to totals due to rounding.

creation of new departments and offices to carry out expanded functions and programs.

An example of a recent government program is medical care under the Philippine Medical Care Act of 1969. The Medicare program, coupled with the rapid population growth in the country, has brought about an increased demand for medical and health workers in government. In 1966, the national government employed some 2,804 physicians to work in hospitals (1,204), rural health units (1,448), provincial health offices (112) and city health offices (40).[11] This represented 23.3 per cent of the estimated number of 12,000 physicians actively practicing in the country. By 1970, the number of physicians employed by government had reached over 4,000 or 37.8 per cent of a total of 13,101 physicians. About one-third of all the physicians (32.7 per cent) were in the Department of Health. Some 60 per cent of physicians were in the private sector: 40.3 per cent in private practice, 11.7 per cent in private hospitals, 3.4 per cent in academic medicine, and 2 per cent in private industry.[12] Despite this increase in the number of physicians, many rural health units have been reported without a resident physician.

The national program of increased food production has similarly created a greater need for scientists specializing in agriculture and the biological sciences. In line with this program, the government has

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[11] Paulo C. Campos, "Employment Effects of a Rural Health Strategy for the Philippines," Papers and Proceedings of the Workshop on Manpower and Human Resources, The Philippine Economic Journal, Number Twenty Three, Vol. XII, Nos. 1 and 2 (1973), p. 99.

[12] Quintin L. Kintanar, "Health Manpower Requirements for National Development," Science Forum 1974 on National Development: Its Scientific and Technological Manpower Component (Los Baños: Society for the Advancement of Research (SAR), Inc., April 1974), p. 25. Some 2.9 per cent of the total number of physicians were inactive.

given impetus to scientific research among its agencies. In 1972, the Philippine Council for Agricultural Research (PCAR) was created to help implement and coordinate research activities in accordance with the goals of increased food and other production.[13] A survey conducted by PCARR of 63 government and private agencies in 1973 showed a total of 2,213 scientists engaged in agricultural research. Most of these (40 per cent) were found in universities and colleges, both state-owned and private. The rest were found in the Department of Agriculture and Natural Resources (30 per cent), private agricultural industries (10 per cent), the National Science Development Board (8 per cent), commodity institutes (5 per cent), and the rest (7 per cent) were in other government and private entities.[14]

The scientists were found to be spending only half of their time doing actual research. Measured in terms of scientist man-years (a scientist man-year being equivalent to full-time work devoted to research for a year), the 2,213 scientists surveyed by PCARR contributed a total of 1,097.6 scientist man-years to agricultural research. PCARR projected the need for additional research scientists who could provide 1,646 scientist man-years by 1978. This meant an increment of about 200 agricultural scientists each year.

The government's program of promoting proper exploitation and conservation of fisheries and aquatic resources has likewise led to an assessment of required scientific and technological personnel in this area.

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[13] PCAR is now known as the Philippine Council for Agriculture and Resources Research (PCARR).

[14] J.C. Madamba, "The Scientific and Technological Manpower Component in Food and Agriculture Sciences," Science Forum 1974 on National Development, op. cit., p. 82.

In 1975, the Director of the Bureau of Fisheries and Aquatic Resources revealed that, among others, 6,864 engineers were needed within the next year for the proper exploitation, utilization and conservation of fishery and aquatic resources.[15] Moreover, the long-term need for teams of scientists and engineers to undertake the functions of systematic fishery management, fishery education, training and research was emphasized. Thus the future demand for such specialists as oceanographers, meteorologists, marine biologists, microbiologists, electrical and marine engineers, and the like was noted.

Similarly, greater concern with air and water pollution abatement has created a demand for relevant scientific and technological manpower in both the national government and private industry. Specialists in various aspects of environmental science such as, for example, biology, chemistry, physiology, systems analysis, sanitary and pollution control engineering, and others will increasingly be needed. They will be employed in such governmental agencies as the National Pollution Control Commission, Departments of Health, Agriculture, and Natural Resources, as well as in private industry. In the above-mentioned agencies, they will undertake research on environmental pollution, inspection, monitoring and regulation of industries.[16]

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[15]Felix R. Gonzales, "Education and Training Requirements for Fisheries and Aquatic Resources Conservation," Science Review, Vol. XVI, No. 4 (July-August 1975), p. 25.

[16]Bienvenido N. Garcia, "Education and Training for Air and Water Pollution Abatement Program in the National Government," Science Review, Vol. XVI, No. 4 (July-August 1975), pp. 34-36; National Science Development Board and National Pollution Control Commission, Workshop on Education and Training Needs for Philippine Environmental Programs (Manila: 27-31 May 1974), pp. 17-19, 60-69, 76-81.

The national government's involvement in the search for alternative sources of energy has also led to an increased demand for mining engineers, metallurgical engineers and geologists.[17] An indication for this demand has been the high starting salary offered for new graduates in these fields by the Bureau of Mines. In 1974, it was offering ₱1,300 a month as starting salary for these personnel which was much higher than that offered by state universities and colleges for the same qualifications. The increase in government infrastructure development projects in highways, bridges, dams, has led to a demand for more civil, mechanical and other specializations in engineering. Interviews with the dean of an engineering college in the Visayas and the president of a state college in Northern Luzon revealed their difficulties in recruiting faculty members for their engineering departments. A common reason given by both school officials is the demand for civil and mechanical engineers by government agencies in their regions and the higher starting salaries that they offered which their institutions could not afford to match.[18]

An indicator of increased employment opportunities for scientists and engineers in private industry is the growth of manufacturing establishments since 1965 when the survey of scientific and technological manpower was undertaken by NSDB. At that time, there were 8,044 establishments employing five or more workers with a total of 316,415 employees. By 1970, the number of these establishments had increased to 10,494 with an aggregate employment of 402,064. In 1974, this number had reached

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[17] P.K. Guerrero, "The Scientific and Technological Manpower in the Engineering Sciences," Science Forum 1974 on National Development, op.cit., p. 77.

[18] Interviews with the Dean of the College of Engineering, University of San Agustin, Iloilo City, 25 April 1977; and the President of Isabela State College of Agriculture, 7 May 1977, Echague, Isabela.

13,313 and employed a total of 531,973 workers.[19]

The study group on vocational-technical education of the Presidential Commission to Survey Philippine Education in 1970 made a survey of 116 firms employing a total of 94,498 workers. Though limited in coverage, the results of this survey can give insights into the employment of scientists and engineers in the private sector. Looking at the distribution of the work force according to function, management and staff numbered 9,259 or 9.7 of total workers. Employees in sales numbered 9,532 or 10 per cent and the remaining 76,708 or 80 per cent were production workers. The latter group was distributed into scientists, 166 (.2 per cent of production workers), engineers, 2,831 (3.7 per cent), technicians, 5,404 (7 per cent),and the remaining were skilled workers, 33,040 (43 per cent) and unskilled workers, 35,267 (46 per cent).[20]

It is very likely that there were many trained scientists and engineers in the management and staff of the firms surveyed by the study group on vocational-technical education. For example, a study made on the utilization of engineering graduates in Philippine industry in 1974 found out that 62 per cent of engineering graduates were employed as industrial managers rather than as engineers and that managerial activities were very important even for those who were employed as engineers.[21]

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[19]Republic of the Philippines, National Economic and Development Authority, 1977 Philippine Statistical Yearbook (Manila: March 1977), p. 290.

[20]Presidential Commission to Survey Philippine Education, Special Area Group for Vocational-Technical Education, Vocational-Technical Education in the Philippines, a Report (Quezon City: National Manpower and Youth Council, 1974), p. 87.

[21]Gaston Z. Ortigas, "The Utilization and Development of Engineering Graduates in Philippine Industry" (Ph.D. dissertation, submitted to Harvard University, 1974).

The Special Area Group on Vocational-Technical Education found in its study that many of the 116 firms surveyed could not project their estimated manpower requirements. Of the few who gave estimates of their needed manpower for 1971 to 1973, the following figures emerged.

Table V-11
Projected Manpower Requirements of 116 Industrial Firms
1971-1973

Employment Type	Year			Total	
	1971	1972	1973	Number	Per Cent
Management/Staff	285	344	264	893	4.3
Sales	190	156	171	517	2.5
Production	7,120	5,769	6,638	19,527	93.3
Total	7,595	6,269	7,073	20,937	100.0
Production:					
Scientists	7	4	7	18	0.1
Engineers	290	269	253	812	4.2
Technicians	382	1,098	458	1,938	9.9
Skilled Workers	2,811	2,253	2,655	7,719	39.5
Nonskilled Workers	3,630	2,145	3,265	9,040	46.3
Total	7,120	5,769	6,638	19,527	100.0

Source of Data: Presidential Commission to Survey Philippine Education, Special Area Group for Vocational-Technical Education, Vocational-Technical Education in the Philippines (Quezon City: National Manpower and Youth Council, 1974), p. 134.

Details may not add up to totals due to rounding.

It can be seen from the above data that the projected demand for engineers in the firms surveyed was 44 times more than that of scientists.

Twenty-four agricultural firms were also sampled by the study group to find out the needed manpower in agro-based industries. The firms gave the following employment projections:

Table V-12
Degree Holders Needed in 24 Agricultural Firms
1971-1973

Field of Specialization	Present Employment: Number	Present Employment: Per Cent	Projected Needs: 1971	1972	1973	Total	%
B.S. in Agriculture	72	52.2	40	42	74	156	50.8
B.S. in Forestry	-	-	-	10	-	10	3.3
Others*	66	47.8	33	48	60	141	45.9
Total	138	100.0	73	100	134	307	100.0

Source of Data: PCSPE, Special Area Group for Vocational-Technical Education, Vocational-Technical Education in the Philippines (Quezon City: National Manpower and Youth Council, 1974), p. 134.

*B.S. in Food Science, Doctor of Veterinary Medicine, etc.

The studies cited give insights into the growing employment opportunities of science and engineering graduates in the private sector. There seems to be very few scientists in the private sector who are employed in strictly research functions. This may be explained by the fact that industrial research is an expensive and time-consuming undertaking. Many of the country's private establishments tend to be small, and, hence, do not conduct much research and development.[22] Moreover, even among the large industrial establishments, there has been an increasing number of multinational corporations. As of 1977, there were

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[22]For example, in 1974, of the total of 13,313 private establishments employing 5 or more workers, only 2,843 (21.4 per cent) had 20 or more workers. These large establishments had an aggregate employment of 454,200 or 85.4 per cent of the total of all establishments with 5 or more workers. See NEDA, 1977 Philippine Statistical Yearbook, op. cit., p. 290.

100 multinational firms, 80 per cent of which were American.[23] Research in these corporations (even in an industrialized country like Canada[24]) tends to be done largely by the foreign-based parent company. Local branch plants would thus be mainly concerned with production and packaging operations. A recent study has shown, for example, that the Philippine drug industry, which is dominated by multinationals, is actually an importing-compounding-packaging industry.[25]

These trends in the employment of scientists and engineers in the national government and industry inevitably affect educational institutions as well. As was shown in Chapter III, universities and colleges have produced relatively few graduates in the sciences, especially in the agricultural and physical sciences, and engineering. It is inevitable, therefore, that there would be shortages of scientific personnel in these fields of specialization in all sectors, given some of the projected demands examined. The Special Area Group on Science Education of the Presidential Commission to Survey Philippine Education and the Senate Committee on Education, in fact, pointed to the lack of qualified science teachers in their studies of educational institutions in 1970-71. This was considered particularly serious in such fields as physics,

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[23]"Seek Remedy to Multinational Ills in RP," U.P. Newsletter, Vol. V, No. 4 (31 January 1977), pp. 1, 8.

[24]E.W.R. Steacie, former President of the National Research Council of Canada, pointed out that Canadian industry was dependent on research done in Great Britain and the United States. See Science in Canada; Selections from the Speeches of E.W.R. Steacie, ed. by J.D. Babbit (Toronto: University of Toronto Press, 1965), especially pp. 115-135.

[25]Esteban B. Bautista, "The Truth About the Drug Industry in the Philippines," U.P. Newsletter, Vol. IV, Nos. 45-46 (15 and 22 November 1976).

mathematics, the biological and other natural sciences.[26]

With the continuing expansion of universities and colleges in the 1970s, it can be expected that these shortages have now become even more serious. Since salaries in private industry tend to be higher than those offered by private colleges and universities, and to some extent even the national government, it may be anticipated that the better qualified scientists and engineers in the latter sectors will be attracted to industry. This phenomenon would seriously impair the development of quality education for science and technology. In the interviews with educators conducted for this study, which are discussed further in Chapter VIII, it was found that this has been a problem experienced by several colleges and universities particularly those outside Manila. This situation creates a vicious circle whereby universities and colleges are unable to meet the demand for highly qualified science and engineering graduates by industry and expanding national government programs because their competent faculty are "pirated" by the latter sectors or overloaded with teaching and other responsibilities. If one adds to this picture the loss of scientists and engineers to foreign countries, the development of Philippine science may become further impaired.

Summary and Conclusion

This chapter has shown that there is a dearth of reliable, up-to-date and comprehensive data on the number and distribution of scientists and engineers in government, private industry and educational institutions,

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[26]Republic of the Philippines, Presidential Commission to Survey Philippine Education, Report of the Special Area Group on Science Education (Manila: May 1971, mimeo.), *passim*; Republic of the Philippines, Congress, Senate Committee on Education, Higher Education Research Council, Higher Education in the Philippines, 1970-71, Vol. I (Manila: 1972, mimeo.), pp. 276-284, 310-363, 548-567.

their background and training and the kind of work that they perform. From available information, it was seen that most of the scientists and engineers were employed by private industry. Compared with those in the national government, scientists in the private sector possessed higher educational qualifications. The surveys indicated that most of the scientists and engineers in private industry were engaged in production, operations, management and sales. There seemed to be little research done in this sector.

There were more scientists in the national government engaged in research. As the surveys showed, about a third of the government scientists were in research and development. The kind of research done by these scientists is mostly mission-oriented, applied research. Basic research is usually undertaken in universities and colleges although the studies revealed that only a minority of university scientists are actually engaged in it. The overwhelming majority of academic scientists were found to be solely engaged in teaching. This situation tended to reflect the preponderance of private universities and colleges in the country as discussed in Chapter III. Many of these institutions were established primarily to meet the social demand for degrees or diplomas rather than to provide quality education. Much of the research undertaken in universities and colleges were undoubtedly done in the state-owned institutions and explains the preponderance of researchers in the agricultural and biological sciences. Findings of the surveys tend to point to the weak role of universities and colleges in generating new scientific knowledge through either pure or targeted basic research as well as the application of world science to Philippine needs. Such a situation is hardly conducive to the healthy development of Philippine science.

It is apparent from the discussion in this chapter that the demand for scientists and engineers has been increasing with the expansion of governmental functions and programs and the overall economic development of the country. However, the lack of adequate and up-to-date information on the supply and demand for scientists and engineers has hampered manpower planning for development needs. Ideally, such planning would serve as a guide for the expansion of academic programs in universities and colleges as well as for the allocation of government funds for higher education, the state scholarship program administered by the Department of Education and Culture and the science scholarship program of the National Science Development Board. The scholarship programs are necessary to attract the best students into science and engineering careers. A national manpower plan would also provide both students and guidance counsellors in universities and colleges a better idea of prospective employment and career opportunities.

There is a need for continuous inventory of the number and demand for scientists and engineers in the country. Systematic surveys such as those sponsored by the NSDB in 1965 to 1968 undoubtedly provide such information, but given the time and resources needed to conduct them, these can hardly be expected to remain current. The professional associations should be tapped to help meet this need. They should be encouraged to make annual surveys of their own membership as part of their regular activities. Such an undertaking will actually redound to the mutual benefit of government, industry and educational institutions (for planning purposes) and of the professional and scientific community (for a more integrated organization and membership). This could be facilitated by the establishment of common headquarters for all these associations as suggested in Chapter IV.

The next chapter will examine the government agencies responsible for nurturing the development of science in the Philippines and the attempts to define a national science policy.

Chapter VI

Government Science and the Structures and Processes of Science Policy Formulation and Implementation

The National Science Development Board (NSDB) is entrusted with the responsibility of integrating, coordinating and intensifying scientific and technological research and development in the Philippines. Its creation in 1958[1] was the outcome of studies showing the adverse effects of government neglect of science for national development. It is the principal government agency which is concerned with what has been called the function of "providing for science".[2]

Organized like a holding company, the NSDB is made up of several organic and attached agencies. Some of these predate NSDB, others were created after NSDB was established. The functions of these agencies vary. Some are engaged mainly in research and development. Others have regulatory and service functions with relevant research. A few are primarily funding and coordinating bodies. To understand better NSDB's present structure and role, a brief history of science and science agencies is needed. This is outlined in Chart VI-1.

Development of Science Agencies

Scientific work during the Spanish regime was mainly confined to pharmacy and medicine and concentrated on the problems of infectious

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[1]Republic Act No. 2067, otherwise known as "Science Act of 1958," 13 June 1958.

[2]Michael Moravcsik, Science Development: The Building of Science in Less Developed Countries (Bloomington: Indiana University, PASITAM, 1976), p. 121.

Chart VI-1*
Evolution of NSDB and Related Agencies

Year Created	Agency and Major Function(s)	Comments
1887	Laboratorio Municipal de Ciudad de Manila. Performed research for public health and medico-legal cases.	Absorbed by Bureau of Government Laboratories
1901	Bureau of Government Laboratores. Conducted biological and chemical research.	Replaced by Bureau of Science.
1905	Bureau of Science. Performed research in biological and medical sciences, chemistry, fisheries, ethnology, etc.; produced vaccines, serums and prophylactics needed by Bureau of Health;trained Filipino scientists.	Reorganized several times. Now National Institute of Science and Technology, NSDB.
1933	National Research Council of the Philippines. To promote scientific research and act as government science adviser.	Now an attached agency of NSDB. Funds basic research.
1947	Institute of Nutrition, Office of the President. To perform research, advisory and extension functions on nutrition.	Now Food and Nutrition Research Institute, NSDB.
1952	Science Foundation of the Philippines, Office of the President. To stimulate research in sciences and engineering by means of grants and scholarship awards; promote science consciousness among people.	Now an attached agency of NSDB.
1952	Commission on Volcanology. To perform basic research on volcanology.	Now an organic agency of NSDB.
1958	National Science Development Board (NSDB). To formulate national science and technology policies and programs; coordinate scientific and technological research; ensure an adequate supply of scientific and technological manpower. Organic agencies:	Now made up of five organic and six attached agencies.
	National Institute of Science and Technology. To perform scientific research and development, some regulatory and service functions.	
	Philippine Atomic Energy Commission. To perform research and regulatory functions on atomic energy	Transferred to Office of the President in 1974.

*Continued next page.

Chart VI-1 (continued)
Evolution of NSDB and Related Agencies

Year Created	Agency and Major Function(s)	Comments
1963	Philippine Science High School. To provide secondary instruction with special emphasis on science.	Now an attached agency of NSDB.
1964	Philippine Coconut Research Institute, NSDB. To conduct research on coconut production and train manpower for development of coconut industry.	Removed from NSDB in 1973.
1964	Philippine Inventors Commission, NSDB. To promote the development of inventions and their manufacture.	Remains an organic agency of NSDB.
1964	National Water and Air Pollution Control Commission, Office of the President. To undertake research and regulatory functions on pollution.	Now National Pollution Control Commission.
1966	Metals Industry Research and Development Center. Perform metallurgical research and provide technical assistance to industries.	Since 1973, an attached agency of NSDB.
1967	Philippine Textile Research Institute, NSDB. To undertake research on local production of raw materials, improvement and invention of machinery for textile industry.	Remains an organic agency of NSDB.
1969	Forest Products Research and Industries Development Commission, NSDB. To perform research and development on wood and other forest products; conduct training programs and provide technical assistance to industries.	Remains an organic agency of NSDB.
1972	Philippine Council for Agriculture and Resources Research. Formulate and Coordinate national research program for agriculture and resources research.	Remains an attached agency of NSDB.
1977	Technology Resource Center. To provide a link between producers and users of scientific and technological research.	NSDB Chairman heads TRC's Executive Committee.

Sources of data: Laws creating agencies. Refer to text.

diseases, their causes and possible remedies.[3] Even before the establishment of the college of medicine at the University of Santo Tomas (UST) in 1871, some medical research was being done in several hospitals that had been set up as early as 1578. By the second half of the nineteenth century, studies of infectious diseases such as smallpox[4], cholera, bubonic plague, dysentery, leprosy and malaria were intensified with the participation of graduates in medicine and pharmacy from UST.[5]

In 1887, the Laboratorio Municipal de Ciudad de Manila was created by decree. Its main functions were to conduct biochemical analyses for public health and to undertake specimen examinations for clinical and medico-legal cases. It had a publication called Cronica de Ciencias

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[3]Eulogio B. Rodriguez, "Brief Observations on Science in the Philippines in the Pre-American Era," National Research Council of the Philippine Islands (NRCP), Annual Report, 1934-35, Bulletin No. 3 (Manila: February 1935), pp. 84-128; J.P. Bantug, "The Beginnings of Medicine in the Philippines," NRCP, op. cit., Bulletin No. 4, pp. 227-246; Vicente Ferriols, "Early History of Veterinary Science in the Philippine Islands," NRCP, ibid., pp. 334-337; M. V. del Rosario, "Chemistry in the Pre-American Regime," NRCP, op. cit., Bulletin No. 5, pp. 359-362.

[4]As early as 1803, an edict was passed to control smallpox by introducing vaccination. In 1806, a Board of Vaccination was set up to take charge of the propagation and preservation of the virus against smallpox. See Hilario Lara, "Development of Hygiene and Preventive Medicine (Public Health) in the Philippines," NRCP, op. cit., Bulletin No. 4, pp. 265-266.

[5]Specimens were usually submitted to pharmacists for examination. Thus drugstores, notably the Botica Boie and Botica de Santa Cruz in Manila, served as research laboratories as well as manufacturers of drugs and household remedies. See Patrocinio Valenzuela, "Pharmaceutical Research in the Philippines," in NRCP, op. cit., Bulletin No. 5, pp. 404-406.

Medicas de Filipinas showing scientific studies being done during that time.[6]

Research in agriculture and industry during the Spanish regime was encouraged by the founding of the Real Sociedad Economica de los Amigos del Pais de Filipinas (Royal Economic Society of Friends of the Philippines) by Governor Jose Basco y Vargas under authority of a royal decree of 1780. Composed of private individuals and government officials, the Society functioned somewhat like the European learned societies during the eighteenth and nineteenth centuries and a modern National Research Council.[7] It undertook the promotion of the cultivation of indigo, cotton, cinnamon, and pepper and the development of the silk industry. During the nineteenth century, it was endowed with funds which it used to provide prizes for successful experiments and inventions for the improvement of agriculture and industry; to finance the publication of scientific and technical literature, trips of scientists from Spain to the Philippines, professorships; and to provide scholarships to Filipinos.

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[6] Anacleto del Rosario, one of the first graduates of pharmacy at UST, was appointed as the first director of the Laboratorio. He pioneered in bacteriological research, particularly in the search for causes of cholera, tuberculosis and leprosy and investigated the origin of beri-beri which was one of the leading causes of death during that time. See Miguel Ma. Varela, S.J. et al, Scientists in the Philippines (Taguig, Rizal: National Science Development Board, 1974), pp. 173-189.

[7] The Society's early organization included sections of natural history, agriculture, and rural economy, factories and manufactures, industries and popular education. See Benito Legarda, Jr., Foreign Trade, Economic Change and Entrepreneurship in the Nineteenth Century Philippines (Ph.D. dissertation submitted to the Department of Economics, Harvard University, Cambridge, Mass., 1955), pp. 117-119, 321-326; Patrocinio Valenzuela, "A Historical Review of Movements to Establish a Research Council of the Philippines," in NRCP, op. cit., Bulletin No. 3, pp. 77-79.

Meteorological studies were promoted by the Jesuits who founded the Manila Observatory in 1865. The Observatory collected and made available typhoon and climatological observations. These observations grew in number and importance so that by 1879, it became possible for Fr. Federico Faura to issue the first public typhoon warning. The service was so highly appreciated by the business and scientific communities that in April 1884, a royal decree made the Observatory an official institution run by the Jesuits, and also established a network of meteorological stations under it.[8] In 1901, the Observatory was made a central station of the Philippine Weather Bureau which was set up by the American colonial authorities. It remained under the Jesuit scientists and provided not only meteorological but also seismological and astronomical studies.

Various offices and commissions were also created by the Spanish government to undertake studies and regulations of mines, research on Philippine flora, agronomic research and teaching, geological research and chemical analysis of mineral waters throughout the country.[9] However, little is known about the accomplishments of these scientific bodies.

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[8]The meteorological studies done at the Observatory, notably by Jose Algue Sanllei, became world renowned. Some were subjects of discussion at International Meteorological Congresses and were published in the Journal of the Royal Meteorological Society in London. See John N. Schumacher, "One Hundred Years of Jesuit Scientists: The Manila Observatory 1865-1965," Philippine Studies, Vol. 13 (1965), pp. 258-286; Varela, op. cit., pp. 1-22.

[9]These were the Inspeccion General de Minas created by Royal Decree in 1837; Comision de Flora de Filipinas, 1876; Comision Agronomica de Filipinas, 1881; Comision Especial de Estudios Geologicos y Geograficos de Filipinas, 1885; and Comision de Estudios de las Aguas Minero Medicinales, 1884. See Leoncio Lopez Rizal, "Scientific and Technical Organizations in the Philippine Islands," in NRCP, op. cit., Bulletin No. 3, pp. 155-159.

During the American regime, the development of science gained more government support along with efforts to establish an extensive public school system and public health programs. The old Laboratorio Municipal was absorbed by the Bureau of Government Laboratories created by the Philippine Commission in 1901. In 1905, the latter was reorganized and renamed Bureau of Science. It remained the principal government research establishment until the end of the second World War. It had a biological laboratory, a chemical laboratory, a serum laboratory for the production of vaccine virus, serums and prophylactics, a division of ethnology, a division of fisheries and a scientific library. Most of the senior scientists in the Bureau were initially Americans but as Filipinos acquired the necessary training, they gradually took over their positions.[10]

The Bureau of Science served as a valuable training ground for Filipino scientists.[11] It performed the needed chemical and biological examinations for the Philippine General Hospital and Bureau of Health

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[10]Dean Worcester, a zoologist from the University of Michigan who became a member of the Philippine Commission and Secretary of the Interior, was responsible for planning the organization of the Bureau of Government Laboratories. He envisioned the close collaboration and coordination of scientific efforts between the staff of the future College of Medicine of the University of the Philippines, Philippine General Hospital, Bureau of Health and Bureau of Government Laboratories. Dr. Paul Freer, a physician with advanced training in chemistry, also from the University of Michigan, helped prepare the plan as well as implemented it as the first Director of the Bureau of Government Laboratories. See Dean Worcester, The Philippines Past and Present, Vol. I (London: Mills and Boon, 1914), pp. 488-499.

[11]Staff members of the Bureau held concurrent appointments as faculty members of the College of Medicine of the University of the Philippines and other units of the University, as well as appointments at the Philippine General Hospital. Officers of the Bureau of Health were likewise appointed to the faculty of the College of Medicine. All of these scientists conducted their research work at the Bureau of Science.

and manufactured the serums and prophylactics needed by the latter. Pioneering research was done at the Bureau of Science on such diseases as leprosy, tuberculosis, cholera, dengue fever, malaria and beri-beri. Results of these studies were readily available to the Bureau of Health for use in its various programs.[12] Studies on the commercial value of tropical products, tests of Philippine minerals and roadbuilding materials, the nutritional value of foods, and others were similarly done at the Bureau of Science. From 1906, it published the Philippine Journal of Science which reported not only work done in local laboratories but also scientific developments abroad which had relevance to Philippine problems.[13]

The American colonial authorities organized other offices which, by the nature of their operations, contributed further to the growth of scientific research. These were the Weather Bureau (1901), the Board (later Bureau) of Health (1898), Bureau of Mines (1900), Bureau of Forestry (1900), Bureau of Agriculture (1901), Bureau of Coast and Geodetic Survey (1905), Bureau of Plant Industry (1929) and Bureau of

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[12] A former Governor General, W. Cameron Forbes wrote that in the Bureau of Science "was created one of the first large public health laboratories under the American flag. Since then laboratories doing similar work have been created in nearly every state and city of the United States and extensively emulated abroad." See his The Philippine Islands, Vol. I (Boston and New York: Houghton Mifflin Co., 1928), p. 365.

[13] In the first decade of the Philippine Journal of Science, less than ten per cent of published articles were authored by Filipinos. Many of these surveyed the country's flora and fauna. See J.R. Velasco, "Manpower Needs in the Biological Sciences," Science Forum 1974 on National Development: Its Scientific and Technological Component (Los Baños: Society for the Advancement of Research, Inc., April 1974), p. 10.

Animal Industry (1929).[14] From 1927, there were proposals from professional societies for the creation of a National Medical Research Council and a National Research Council similar to those in the United States, Canada, and Australia.[15] The Philippine Legislature passed an Act in 1933 creating the National Research Council of the Philippine Islands (NRCP).[16] Aside from working for the promotion of scientific research, the NRCP actively participated in the deliberations and drafting of provisions affecting science and industry in the 1934 Constitutional Convention.

At the time of NRCP's establishment, Vice Governor Joseph Ralston Hayden observed that the scientific work done in government agencies and the University of the Philippines lacked coordination. He pointed out that "professional, institutional, political and even racial jealousies [had] at times caused a diffusion and overlapping of effort which [had] injured the public interest and reduced the effectiveness of the large body of well-trained Philippine scientists."[17] In 1933, the Bureau of Science was reorganized and many of its functions and

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[14] Rizal, op. cit., pp. 169-176.

[15] The creation of a National Medical Research Council in the Philippine Islands was proposed by the Philippine Islands Medical Association and the Colegio Medico-Farmaceutico de Filipinas during separate meetings in 1927. The latter similarly sponsored in 1931 a meeting to discuss proposals for the establishment of a National Research Council of the Philippine Islands. This was further discussed at the Second Philippine Science Convention sponsored by the Philippine Scientific Society in February 1933. See Valenzuela, "A Historical Review of Movements to Establish a Research Council for the Philippines," op. cit., pp. 80-83.

[16] Act No. 4120, 8 December 1933. The NRCP was first organized in 1934 with 114 chartered members appointed by the Governor General. Its initial funding came from the Department of Agriculture and Commerce.

[17] Joseph Ralston Hayden, The Philippines, A Study in National Development (New York: The Macmillan Co., 1942), p. 543.

personnel, including its scientific library were transferred to the Department of Agriculture and Commerce. Hayden viewed these changes as detrimental to the development of science in the Philippines. He considered these not just "mistakes in policy" but also showed the Filipino officials' "lack of understanding" of the importance of science in national development. Another American, who wrote about this reorganization of government science, deplored the "lack of understanding in government political and even Filipino scientific circles of the importance of the continued employment of able scientists from abroad." He thought that the "greatness of the Bureau of Science was sacrificed to a narrow nationalism which as time has proved, did great damage to the country as a whole without improving the status of Filipino scientists."[18]

The work of the reorganized Bureau of Science shifted to more applied industrial research. This was criticized as merely supplementing

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[18] A.V.H. Hartendorp, "The Recovery of Philippine Science," The American Chamber of Commerce Journal, Vol. XXXIV, No. 4 (April 1958), p. 154. It is interesting to compare Hartendorp's view with that of Francis Burton Harrison, a former Governor General who during his term of office worked for the Filipinization of the colonial bureaucracy despite opposition from many American officials. Harrison wrote:

> No disposition was shown at any time by the Filipinos to desire offices of a technical nature...for which they had no men of sufficient experience or training. It seems probable that in the event of independence they will make an effort to secure the services of American advisers or directors for bureaus of a scientific or technical nature after the manner of Japan during her first thirty years of her entry into modern forms of government.
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> while Filipinos have by now come to occupy most of the posts of tactical or administrative power, they have shown prudence in approaching the scientific or technical branches of office-holding, and they manifest a genuine appreciation of the services of those Americans who have continued to work for their welfare and the development of their country.

See his The Cornerstone of Philippine Independence: A Narrative of Seven Years (New York: The Century Co., 1922), pp. 86-87.

the work already done by other agencies. Declining appropriations for the Bureau of Science was also cited as evidence of the Philippine legislature's diminishing support for scientific research. However, it should be noted from Table VI-1 that major reductions in appropriations for the Bureau coincided with the transfer of some of its units to other agencies and did not necessarily mean a decline in government support for science.

Table VI-1
Appropriations for the Bureau of Science, 1930 to 1936

Year	Amount	Year	Amount
1930	₱754,420	1937	₱350,225
1931	735,911	1938	567,493
1932	673,891	1939[d]	508,966
1933[a]	369,025	1939-40[e]	317,430
1934	337,026	1940-41	287,599
1935[b]	550,119	1942-44[f]	-
1936[c]	461,413	1945-46	264,292

Source: A.V.H. Hartendorp, "The Recovery of Philippine Science," The American Chamber of Commerce Journal, Vol. XXXIV, No. 4 (April 1958), p. 157.

The rate of exchange during this period was ₱2 to US $1.

[a]Division of Fisheries, Division of Zoology, Library Division and Division of Publications transferred to the Department of Agriculture and Commerce.

[b]Transferred Divisions returned to the Bureau of Science.

[c]The following units were transferred to other entities: Biological Products and Alabang Power Plant; Pasteur Treatment; Cebu and Iloilo Laboratories; Home Economics Division; Nutrition Laboratory; Division of Mines; and Tiki-tiki plant.

[d]Division of Soils Survey transferred to Department of Agriculture and Commerce, now Bureau of Soils.

[e]Natural History Museum transferred to Department of Agriculture and Commerce, now the National Museum.

[f]Japanese Occupation.

The Japanese Occupation of the Philippines practically destroyed all that had been accomplished in building up science. From 1946 to 1950, the government faced the task of reconstruction, reorganization and the creation of new agencies. In 1947, the Bureau of Science was reorganized and renamed Institute of Science by President Manuel Roxas. It was placed directly under the Office of the President as was the National Research Council of the Philippines. An Institute of Nutrition was also created to serve as a clearing house of data on nutrition, to advice and coordinate all experimental work in nutrition undertaken by both government agencies and private organizations, conduct research in the applied science of food and nutrition and promote proper nutrition among the population.[19]

In general, there was a lack of planning, coordination and integration of scientific work in government during these years. The U.S. Economic Survey Mission to the Philippines in 1950, headed by Congressman Daniel Bell, noted in its Report the dearth of basic information needed by industries of the country, the neglect of experimental work and the meager appropriations in the national budget for scientific research, including the low salaries of government scientists.[20] The Bell Mission recommended, among other things, the systematic exploration of the

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[19] The reorganization of the Bureau of Science and creation of the Institute of Nutrition were provided by Executive Order No. 94, 4 October 1947. The establishment of the Institute was first proposed in 1926 by Isabelo Concepcion. See his "A Plea for the Establishment of a Government Institute for the Study of Nutrition in the Philippines," Editorial, Journal of the Philippine Islands Medical Association, Vol.VI, No. 10 (October 1926), pp. 339-341.

[20] U.S. Economic Survey Mission to the Philippines, Report to the President (Washington, D.C.: 9 October 1950), cited in A.V.H. Hartendorp, History of Industry and Trade of the Philippines, Vol. I (Manila: American Chamber of Commerce in the Philippines, Inc., 1958), pp. 469-470.

country's natural resources to determine their potentialities for economic development.

In 1951, President Elpidio Quirino reorganized further the Institute of Science and Technology. It was placed under the Office of Economic Coordination and acquired the status of a government-owned corporation. Added to its former functions of resources survey, testing and standardization, were the responsibility for improving industrial processes and stimulating technical development.[21]

Subsequently in 1952, President Quirino signed into law two Acts passed by Congress creating two scientific bodies. The first of these was the Science Foundation of the Philippines (SFP).[22] Organized as a public corporation under the Office of the President, the SFP was to promote and stimulate basic and applied research in the sciences and engineering by means of grants; to award scholarships and graduate fellowships in these fields of study; and promote science consciousness among the people through the organization of science clubs and societies in schools and colleges. Initially, there was no appropriation provided for SFP's operation but it was authorized to receive donations and contributions. The second agency created was the Commission on Volcanology whose main function was to undertake basic researches in that science.[23] The Commission was placed under the supervision of the National Research Council of the Philippines.

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[21] Jose R. Velasco, "A Critique of Our Science Effort in the Last 25 Years," Fookien Times Yearbook (1973), p. 220.

[22] Republic Act No. 770, 20 June 1952

[23] Republic Act No. 766, 20 June 1952.

Concern with the development of science further increased during President Ramon Magsaysay's term. In January 1956, in his third annual state-of-the-nation address, he stressed the need for scientific research as a basis for economic and social development" and declared this as one of the "guideposts" of his Administration.[24] Following the recommendation of the Government Survey and Reorganization Commission, he reorganized the Institute of Science and Technology in 1956 and renamed it National Scientific and Industrial Research Institute.[25] In August of the same year, he signed into law an Act passed by Congress designed to "promote scientific, engineering and technological research, invention and development." The Act also created a National Science Board (NSB) under the Office of the President.[26]

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[24]Quoted in Hartendorp, <u>History of Industry and Trade of the Philippines</u>, <u>op. cit</u>., p. 471.

[25]The Reorganization Commission was appointed by President Magsaysay in accordance with Republic Act No. 997 (9 June 1954). The Commission had observed that the Institute of Science and Technology did not have "the necessary prestige, authority, equipment, or funds to pursue an aggressive program in keeping with other phases of economic development." It recommended that the IST should be strengthened and its missions and functions redefined "to promote a coordinated, long-range program of scientific and industrial research and development." Quoted in Hartendorp, <u>op. cit</u>., pp. 475-476.

[26]Republic Act No. 1606, 23 August 1956, Sec. 1. The NSB was to be composed of 11 members representing the following agencies: National Research Council of the Philippines, University of the Philippines, Science Foundation of the Philippines, Institute of Science and Technology, Philippine Association for the Advancement of Science, Philippine Confederation of Professional Organizations, Department of Agriculture and Natural Resources, Department of Health, Department of Commerce and Industry, National Economic Council and a representative of the manufacturing industries. They were to be appointed by the President with the consent of the Commission on Appointments of Congress. NSB was to administer the government's program of promoting the development of science and technology through the grants of scholarships in science, engineering and technology for gifted citizens; grant of bonuses and other financial aid to deserving researchers; employment of recognized scientists, engineers and technologists to train promising young scientists; extension of travel and research grants to scientists and institutions, and other means.

The NSB's organization had barely started when a report on the condition of Philippine science was submitted to the President in 1957.[27] The report stressed the attrition of Philippine science that had taken place since the early years of the American regime when it was considered to be the "scientific pacemaker of the Far East." The report pointed out that the development of science was neglected by the government during the campaign for political independence. The report showed that there was very little government support of science even after independence. There was a dearth of scientists of high training and ability, low morale among scientists, and a lack of scientific awareness on the part of the public. Among recommendations of the study were an all-out support for scientific work, the establishment of a coordinating agency for science and a long-range program of scientific development. These recommendations were endorsed by the Science Foundation of the Philippines, the Philippine Association for the Advancement of Science and many individuals. Consequently, as we have seen, Congress enacted the Science Act of 1958 creating the National Science Development Board.[28]

Organization of NSDB in 1958

The Board's policy-making body was composed of a chairman, a vice chairman who was concurrently its Executive Director, the Chairman of the National Research Council of the Philippines, Commissioner of the National Institute of Science and Technology, Commissioner of the

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[27]Frank Co Tui, The Status of Science in the Philippines (Manila: Phoenix Press, 1957). A graduate of the College of Medicine, University of the Philippines, who emigrated to the United States, Dr. Co Tui visited the Philippines in 1952 and assisted in the establishment of the Science Foundation of the Philippines. He returned in 1957 and was asked by President Magsaysay to look into the status of scientific research in the Philippines.

[28]Republic Act No. 2067, 13 June 1958. This Act was in effect a revised version of the earlier law creating the National Science Board.

Philippine Atomic Energy Commission, Director of the Office of National Planning of the National Economic Council, a representative from the University of the Philippines designated by its President, and four individuals representing industry, scientific and/or technological societies, agriculture and education. The chairman and vice chairman of NSDB and the four sectoral representatives in the Board were appointed by the President with the confirmation of the Commission on Appointments of the Congress.

The Science Act also created the National Institute of Science and Technology (out of the existing Institute of Science and Technology) and the Philippine Atomic Energy Commission (PAEC). Both Agencies were placed under the direct supervision of NSDB. Each agency was headed by a commissioner and a deputy commissioner who were appointed by the President with the consent of the Commission on Appointments.[29]

NIST was given supervision and control over five research centers: Industrial Research Center, Agricultural Research Center, Medical Research Center, Biological Research Center, and Food and Nutrition Research Center. The latter was created out of the former Institute of Nutrition which was transferred from the Department of Health. PAEC was given supervision and control over the Atomic Energy Research Center.[30]

Growth of NSDB

Since its establishment in 1958, NSDB has grown. In 1964, several laws were enacted which expanded its organization and functions. The first of these, the Philippine Inventors' Incentives Act, created the

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[29] Ibid., Secs. 12-13, 16-17.

[30] Ibid., Secs. 14, 18.

Philippine Inventors Commission (PIC) to promote and encourage the development of inventions and their manufacture.[31] A second law created the Philippine Coconut Research Institute (PHILCORIN) to conduct scientific research and investigations on various aspects of the production of coconut and to train people for the development of the coconut industry.[32] The NSDB chairman was also made chairman of PHILCORIN's Board of Trustees. Both PIC and PHILCORIN were placed under the supervision and coordination of NSDB.

Another law passed in 1964, designed to promote the textile industry of the Philippines, created a special textile research fund which was to be derived from one per cent of the gross sales of textile manufacturers who registered for tax exemptions from 1964 to 1970.[33] On the authority of this law, NSDB established the Philippine Textile Research Institute (PTRI) in 1967.[34] The PTRI is to utilize this special textile research fund to undertaken studies that would enhance the local production of raw materials, improvement and invention of machinery, processes and production methods needed by the textile industry. PTRI is headed by a Textile Research Director who is assisted by an Advisory Committee in the formulation of research policies. The Committee is composed of four representatives of private millers who are recommended by the Textile Mills Association of the Philippines, two members repre-

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[31]Republic Act No. 3850, 14 April 1964.

[32]Republic Act No. 4059, 18 June 1964. PHILCORIN was removed from NSDB's supervision in the reorganization of the Executive Branch in 1973.

[33]Republic Act No. 4086, 18 June 1964.

[34]National Science Development Board, Resolution 246-R.3,3 January 1967.

senting the Department of Agriculture and Natural Resources and the NSDB, and one member-at-large.

In 1969, yet another research agency, the Forest Products Research and Industries Development Commission (FORPRIDECOM) was created and placed under NSDB.[35] At the head of this agency is a commissioner who, until 1972, also sat as a member of the NSDB governing board. FORPRIDECOM's policy-making body is a council composed of the Director of the Bureau of Forestry, Dean of the University of the Philippines College of Forestry, and three persons representing the lumber industry, other forest products industries and the general public.

Present Organization of NSDB

The reorganization of the Executive Branch of the government in 1973 strengthened NSDB's linkages with the National Economic and Development Authority (NEDA) and Department of Education and Culture (DEC). Moreover, its coordinative authority over government science agencies was augmented by the transfer of several agencies such as, for example, the Commission on Volcanology, National Research Council of the Philippines, Science Foundation of the Philippines, from the Office of the President. These became either organic agencies of NSDB or attached to it for purposes of policy coordination or control. These changes were in keeping with the Integrated Reorganization Plan to make NSDB the "primary government agency to stimulate, plan, coordinate and guide

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[35]Republic Act No. 5526, 21 June 1969. FORPRIDECOM was actually reconstituted from the Forest Products Research Institute in the University of the Philippines.

scientific and technological efforts of all other government entities."[36] Chart VI-2 shows the organization of NSDB.

NSDB's policy-making body is a seven-member Board of Governors. Its Chairman and Vice Chairman are appointed by the President for a term of six years. The other members of the Board of Governors are the Secretary of Education and Culture, President of the University of the Philippines, Director General of the National Economic and Development Authority and two members representing education, industry and/or community development who are appointed by the President. The last two positions have never been filled.[37]

The NSDB proper is organized into four services: the Planning Service, Financial and Management Service, Administrative Service, and Education and Public Affairs Service. Within the Education and Public Affairs Service are the Information Division, Education and Training Division, and the Scientific Library and Documentation Division. Since 1963, NSDB has also established 12 regional offices.

Organic Agencies of NSDB

NSDB currently exercises direct supervision and control over six organic agencies. These are the National Institute of Science and Technology (NIST), Commission on Volcanology, Food and Nutrition Research Institute (FNRI), Philippine Inventors Commission (PIC), Forest

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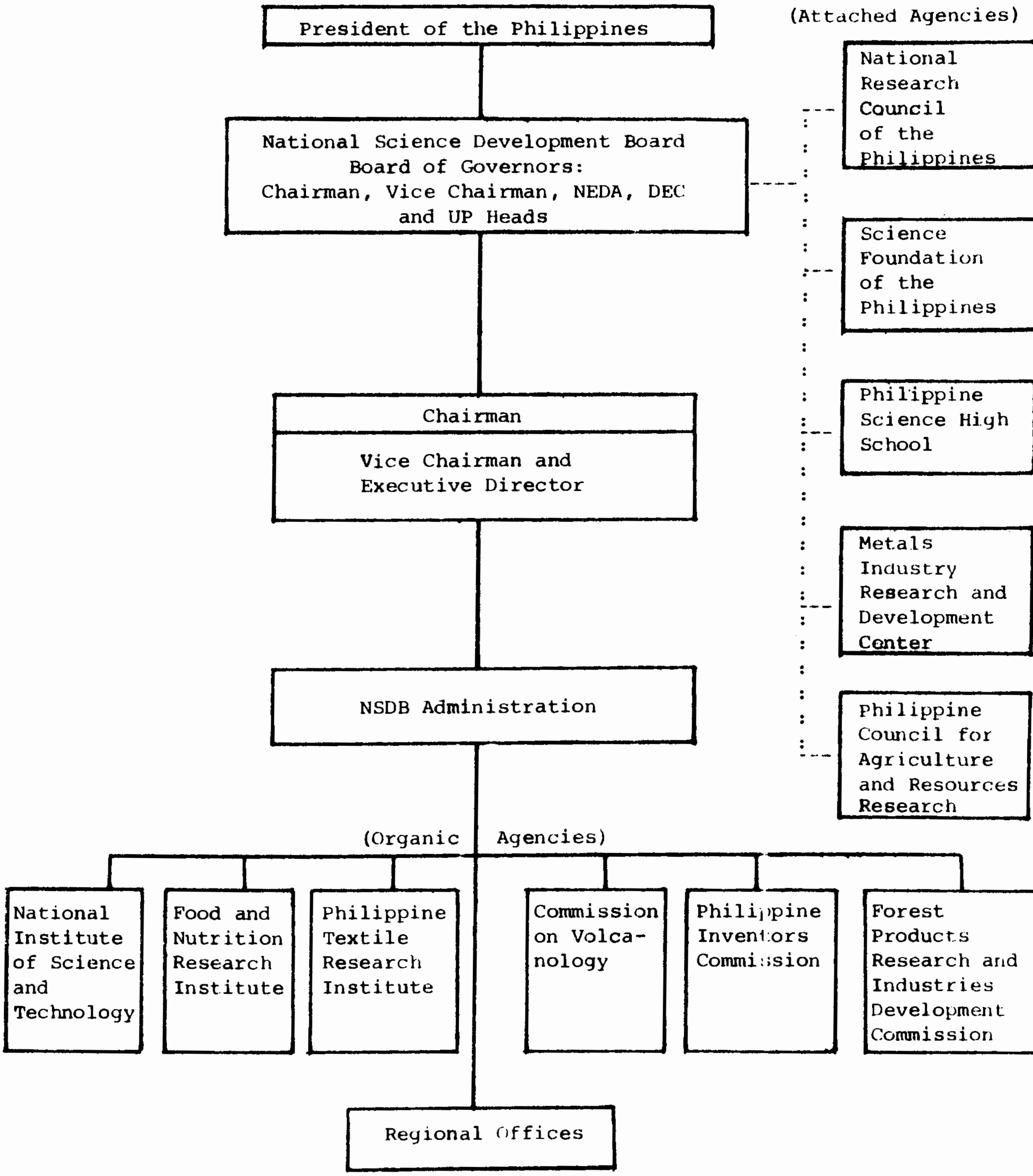
[36] Presidential Commission on Reorganization, The Reorganization of the Executive Branch of the Philippine Government, Vol. I, The Integrated Reorganization Plan (Manila: Lawin Publishing House, Inc., 1973), Article I, Ch. I, Part XIII, p. 157. The Commission on Reorganization was created by Republic Act No. 5435 (9 September 1968). Presidential Decree No. 1, 24 September 1972, authorized the implementation of the Plan.

[37] Interview with the Chairman, National Science Development Board, Metro Manila, 23 March 1977.

Chart VI-2
Organization of the National Science Development Board
(As of July 1977)



Products Research and Industries Development Commission (FORPRIDECOM) and Philippine Textile Research Institute (PTRI). These agencies differ in terms of their major functions, namely research and development, service, and regulatory functions. NIST, FNRI, FORPRIDECOM, PTRI and the Commission on Volcanology are mainly research agencies. However, they also perform certain service functions, generally technical consultancy and advisory services, training of technical manpower and some regulatory function. PIC does mostly service functions.

NIST presently operates a Biological Research Center with three departments (agricultural, medical and microbiological) and an Industrial Research Center with four departments (ceramic, chemical, engineering and food research). Moreover, it has a Tests and Standards Laboratory which performs the agency's service as well as regulatory functions. The Laboratory has been involved in the implementation of Presidential Decree No. 187 which provided for the complete conversion of all existing English and customary units of measurement used in the country to their metric equivalents by January 1975. Senior staff members of the Laboratory have been made members of the technical study committees by the Metric System Board created by the above-mentioned decree. The Metric System Board also designated the Laboratory as custodian of the national physical standards for electricity, luminous intensity and temperature, in addition to length and mass.[38] The Laboratory's regulatory function involves calibration, testing and analysis of articles of commerce such as devices for weights and measures, moisture meter units, testing/analysis of samples and others. The Laboratory is likewise involved in the draft-

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[38]Republic of the Philippines, National Science Development Board, National Institute of Science and Technology, Annual Report for Fiscal Year 1973-74 (Manila: 1974), p. 131.

ing of product specification/standardization in coordination with other government agencies such as the Bureau of Standards and the Bureau of Supply Coordination.

NIST's Scientific Instrumentation Division conducts research on the design and development of scientific instruments, equipment, devices and laboratory glass apparatus for special research application. Its service function includes repair, calibration, test and fabrication of scientific instruments and components as well as laboratory glass apparatus for both government and private entities.

The Food and Nutrition Research Institute (FNRI) used to be NIST's Food and Nutrition Research Center. In 1973, it was made a separate agency under NSDB.[39] Principally a research institution, FNRI has a Food Research Division, Nutrition Research Division and a Medical and Applied Nutrition Division. NIST, through its Food Technology Research Department, continues to conduct researches relating to the food processing industry such as, for example, physico-chemical properties of fruits important to their processing and chemical and microbial hazards in foods.

FNRI's service functions include information campaigns, dissemination of research results as well as providing technical assistance to the National Nutrition Council in the development of nutrition education materials. It assists other agencies in the planning, implementation and evaluation of their nutrition programs.

The Commission on Volcanology is engaged in research (geodetic, geological and geophysical), on volcanic areas of the country for the

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[39]Presidential Decree No. 233, 1 July 1973. It was renamed Food and Nutrition Research Institute on 1 July 1975.

purpose of predicting volcanic eruptions. In this connection, it is responsible for planning operations for disaster relief and coordinating these with other agencies in the event of any volcanic eruption. Increasing concern with alternative sources of energy has expanded the Commission's research thrust. It has stepped up geothermal exploration and undertaken studies on the utilization of geothermal steam for power and other industrial purposes. Alongside its normal duty of investigating volcanic behavior, it has pursued research on earthquake prediction, chemical and mineral analysis of rock, gas and water samples. Moreover, the Commission has been conducting experiments on the utilization of low-pressure natural gas for household purposes.[40]

Primarily a research agency, the Forest Products Research and Industries Development Commission (FORPRIDECOM) undertakes studies on the properties, uses, processing and protection of wood and wood products. It is also engaged in developing technology that will increase the utility, quality and serviceability of wood and other forest products. Its service functions include extending technical assistance and consultancy to new industries using forest products and disseminating information on results of its research and development activities.[41] Cooperative studies and projects are conducted by FORPRIDECOM for private industries, individuals as well as government agencies. Linkages between FORPRIDECOM and the lumber industry, other forest products

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[40] A working model in Angat, Bulacan has been providing energy for a number of households. See Republic of the Philippines, National Science Development Board, Commission on Volcanology, 23rd Annual Report, July 1, 1975-June 30, 1976 (Quezon City: 1976, mimeo.), pp. 20-21.

[41] Republic of the Philippines, National Science Development Board, Forest Products Research and Industries Development Commission, Annual Report of Accomplishments, July 1975-June 1976 (College, Laguna: 30 August 1976), p. 12.

industries, and the general public are provided by three members of its Advisory Council who are appointed to represent these groups.[42] FORPRIDECOM's regulatory functions are "to receive assignment of patents, grant exclusive or non-exclusive rights for their use, charge and collect fees for their use" and to "provide reasonable charges for examination, tests, verifications" and other services.[43]

The Philippine Textile Research Institute (PTRI) conducts research to enhance the productivity of the local textile industry. It has a pilot plant and laboratory facilities to service the needs of textile mills and allied companies. This includes, for example, physical and chemical testing service. It provides advisory and consultancy services to industry and consumer information services. Since 1971, it has undertaken a standardization program which aims to formulate standards for locally produced textiles. Some of its research projects, carried out in cooperation with some state universities and colleges and government agencies such as the Bureau of Plant Industry, are on the economic feasibility of growing cotton in certain provinces, improved production techniques in the local pineapple fiber weaving industry, wastewater treatment plant in textile mills, sericulture (silkworm production), varietal/agronomical studies on banana, ramie, abaca, sisal, kenaf and other indigenous fiber plants and research on their extraction and

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[42]The other members of the reorganized Advisory Council are the Director of the Bureau of Forest Development who sits as Chairman of the Council, Dean of the College of Forestry, University of the Philippines at Los Baños, and retired heads of the FORPRIDECOM as members. See FORPRIDECOM, Annual Report, Fiscal Year 1974-75 (College, Laguna: 30 August 1975, mimeo.), pp. 11, 17.

[43]Republic Act No. 5526, op. cit., Sec. 12.

processing.[44]

More of a service agency, the Philippine Inventors Commission (PIC) provides technical assistance to inventors in securing patents for their inventions, financial assistance to enable them to perfect and produce patented inventions, and legal assistance. It helps inventors find markets, both local and foreign, for their inventions. Moreover, it encourages inventions by sponsoring the annual Inventors Week celebrations, awarding prizes to outstanding inventors and also sponsoring regional invention fairs. It facilitates the use of public research laboratories by inventors who wish to conduct further experiments to perfect approved inventions.

The NSDB Board of Governors appoints and fixes salaries of the Director of PTRI and the Commissioner and Deputy Commissioner of the Commission on Volcanology.[45] Other agency heads, like the Commissioners of NIST and FORPRIDECOM, are appointed by the President upon the recommendation of NSDB.

In general, research and development programs and other activities of these organic agencies are formulated in line with the priorities for science and technology laid down by the NSDB. For purposes of coordination and control, regular meetings between heads of these organic agencies and the NSDB Chairman and Vice Chairman are held at least once a month.[46]

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[44] "Breakthroughs in Textile Research," NEDA Development Digest, Vol. III, No. 23 (30 April 1976), pp. 3-6.

[45] Presidential Commission on Reorganization, op. cit., p. 160.

[46] Interviews with the Chairman and Vice Chairman, National Science Development Board, Metro Manila, 16, 23 and 30 March 1977.

Budgets of these organic agencies have to be approved by the NSDB Board of Governors before they are submitted to the national Budget Commission. Aside from their regular research programs, these agencies can submit in-house research proposals to NSDB for additional funding. There is a decentralization of authority among these agencies with respect to appointments of personnel below a certain level. Commissioners or directors can make appointments generally below the level of division chiefs. Above that level, they need Presidential appointment and, hence, these need to go through the NSDB Board of Governors.

Attached Agencies of NSDB

Five agencies are presently attached to NSDB for policy and program coordination: the Metals Industry Research and Development Center (MIRDC), National Research Council of the Philippines (NRCP), Science Foundation of the Philippines (SFP), Philippine Science High School, and Philippine Council for Agriculture and Resources Research (PCARR).[47]

Just like the organic agencies, NSDB's attached agencies perform varied functions. MIRDC was created by law in 1966 to specialize in metallurgical studies and assist industries by providing services such as tests and analysis of metals.[48] It also provides consultancy services, training for technical personnel and conducts demonstrations for metal industries.

SFP is concerned with planning and undertaking activities to promote science consciousness and better public understanding of science. It

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[47]PCARR was created by Presidential Decree No. 48, 10 November 1972, as the Philippine Council for Agricultural Research (PCAR). Its functions were expanded to include mines research by Presidential Decree No. 864, 29 December 1975. Hence, it was renamed PCARR.

[48]Republic Act No. 4724, 18 June 1966.

assists in the organization of science clubs, science fairs and science quizzes at all levels of schooling. It arranges summer research apprenticeship programs for high school students and science club advisers with the cooperation of the Society for the Advancement of Research which is based in the University of the Philippines at Los Baños. These are aimed at identifying talented students and encouraging them to pursue science careers. SFP receives regular appropriations from the General Fund of the national government. Moreover, NSDB earmarks about five per cent of the Special Science Fund to finance SFP's programs.

The Philippine Science High School is an attached agency which is responsible for providing secondary instruction with special emphasis on the sciences.[49] The school was set up primarily to prepare honor graduates of elementary schools for eventual science careers. It enjoys considerable autonomy from the Department of Education and Culture. Students attending the school are selected on the basis of nation-wide competitive examinations. They enjoy full or partial scholarships, depending on their performance in the examinations and subsequent class standing.[50]

NRCP is mainly a funding agency supporting basic research in the natural and social sciences. It also extends financial support for scientific publications, seminars and symposia as well as travel grants

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[49] Republic Act No. 3661, 22 June 1963.

[50] Students at the PSHS are also eligible for financial grants-in-aid which is based on their parents' income. Since its establishment in academic year 1964-65, PSHS has had 1,171 entrance scholars. Of this total, 76.9 per cent have graduated. A survey of its graduates, conducted by PSHS staff in 1976, showed that 85 per cent have pursued science careers. Interview with the Director, Philippine Science High School, Quezon City, 25 March 1977.

for Filipino scientists to enable them to attend international conferences. Its funds come from General Fund appropriations of the national government as well as grants-in-aid from the Special Science Fund. NSDB allots 10 per cent of this Fund to support basic research. In fiscal year 1975-76, NRCP received ₱1.78 million from the General Fund and ₱4.07 million from the NSDB as its share of the Special Science Fund. About 56.6 per cent were used to support scientific research. Most (83 per cent) of the grants-in-aid given for basic research went to researchers in public universities and colleges. The remainder went to those in private colleges and universities (8 per cent)and to private individuals and other institutions (9 per cent).[51]

The Philippine Council for Agriculture and Resources Research (PCARR) coordinates and manages the country's national program of agriculture and resources research. It was organized in 1973 upon the recommendation of an Executive Panel which had been created by a Presidential Administrative Order in 1971. The Panel had made an extensive study of existing resources for national agricultural research.[52]

PCARR has its own policy-making body, the Governing Council, which is chaired by the NSDB Chairman. The Council's other members are: the

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[51] Republic of the Philippines, National Research Council of the Philippines, Annual Report, 1976 (Taguig, Rizal: February 1977, mimeo.), pp. 14,17, 21.

[52] Some of the Panel's findings were the low priority given to research by agricultural agencies; funds allocated for agricultural research were usually diverted for other purposes like capital outlay; and a conflict of interest existed among research funding institutions which performed in-house research. There was concentration of expertise in some agencies and disciplines, a fragmentation of responsibility and resource allocation; and insufficient mechanism for planning and execution of research projects on a national scale. See National Agricultural Research Survey, Technical Panel, The Philippine Agricultural Research System, Vol. I, Evaluation and Recommendations (Manila: 1971, mimeo.), pp. 71-88.

Secretaries of Agriculture and Natural Resources as Vice Chairmen, Budget Commissioner, a representative of NEDA, President of the Association of Colleges of Agriculture in the Philippines (ACAP), Chancellor of the U.P. at Los Baños, PCARR Director-General, and two outstanding leaders in the producer's and business sectors of agriculture and natural resources who are appointed by the President of the Philippines, upon the recommendation of PCARR Governing Council. Thus in PCARR's Governing Council, government departments, the University of the Philippines, colleges of agriculture and the private sector are represented. Moreover, these sectors, as well as small farmers, are also represented in the National Commodity Research Teams which are responsible for formulating research priorities for each commodity industry. The work of these Commodity Research Teams are further integrated with the problems and priorities identified in PCARR's regional and national research congresses which are held periodically.[53]

PCARR has worked with NEDA officials in the regional congresses in order to ensure the integration of its program of agriculture and resources research with NEDA's economic plans. Compared with NSDB, PCARR has been able to institute an ongoing mechanism for setting up a national research program where priorities are determined with the participation of all relevant sectors -- government, universities and colleges, and the private sector. This mechanism is flexible enough as it is periodically reviewed and evaluated. This was originally instituted in NSDB but has been improved by PCARR and made a regular

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[53]Joseph C. Madamba, "The Philippine Agriculture and Resources Research System Today: A Review," paper read at the 2nd National Agriculture and Resources System Research Congress held at Los Baños, Laguna in November 1976 (mimeo.), pp. 2-3.

part of its research programming, coordination and review.

PCARR's national research program becomes the basis for the allocation of research funds for agriculture, forestry, fisheries, mines and other natural resources. Funds for this program come from regular government appropriations, the Special Science Fund, commodity tax levies, private sector contributions and foreign aid. Government revenues from all sources, whether regular appropriations or grants-in-aid from NSDB earmarked for research in these fields are programmed by PCARR. Research projects in agriculture and natural resources must, therefore, be in accordance with the national program of priorities approved by the PCARR Governing Council.

It was suggested to me in one interview that what PCARR is presently doing should have been done by NSDB.[54] The latter was unable to perform its functions regarding agricultural research because it inherited the old bureaucratic structure. NSDB's leadership merely waited for research proposals which had to be approved on a project basis. Because NSDB was moving very slowly in this area, PCARR had to be created. PCARR has a young aggressive leadership and is not hampered by the old bureaucratic procedures. It lists priority researches that need to be done rather than just rely on individual proposals. It monitors the implementation of its research program through periodic review and evaluation and on the basis of this review, PCARR can recommend the release or withholding of research funds to individuals or institutions. PCARR likewise assists universities, colleges and government agencies in

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[54]Interview with the Chancellor, U.P. at Los Baños, Laguna, 14 February 1977.

developing their research capabilities through its graduate scholarship program for agriculture, fisheries, forestry and related fields.

Funding for NSDB's attached agencies come from their regular appropriations in the national budget as well as grants-in-aid from NSDB as their share of the Special Science Fund. In the case of SFP and NRCP, they are also authorized to receive donations and private grants. Among attached agencies, PCARR has the widest range of concern, both in terms of the number of government agencies, educational institutions and private scientists that it deals with as well as in terms of the research funding that it can control.

Linkages between NSDB and its attached agencies are provided by the NSDB Chairman who is also Chairman of the Board of Trustees of the Philippine Science High School, Chairman of PCARR's Governing Council and Chairman of MIRDC's Board of Trustees.[55] NSDB is represented in the Executive Board of NRCP by the Director of the Philippine Textile Research Institute. NSDB's Vice Chairman sits as member of SFP's Board of Trustees. Budgets of these attached agencies also pass through the NSDB Board of Governors. Release of their share of the Special Science Fund is made by the national Budget Commission only upon recommendation of the NSDB Chairman. Release of their funds for agriculture and resources research projects is controlled by PCARR.

Other Science Agencies

There are a number of science agencies related to NSDB but outside of its formal authority structure. These are the Philippine Atomic Energy Commission (PAEC) and the National Pollution Control Commission

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[55]Interview with the Chairman of NSDB, Metro Manila, 23 March 1977. See also Republic Act No. 3661, Sec. 4; and Presidential Decree No. 864, Sec. 2.

(NPCC). Two others, which have been recently created, are the Energy Development Board (EDB) and the Technology Resource Center (TRC). A look at their organization and functions provides further insights into science policy formulation and implementation.

Philippine Atomic Energy Commission. Originally an organic agency of NSDB, PAEC has been transferred to the Office of the President by Presidential Decree No. 606 on 13 December 1974. The rationale for its transfer, as embodied in the decree's preamble, is the "increased utilization of atomic energy and nuclear energy power development in the country" which has resulted in "highly demanding responsibilities and expanded functions" for PAEC. Because of this, the Office of the President "needs to be informed directly by the Commission on the accelerating pace of international nuclear activities, in the interest of national security and public safety." Interviews with knowledgeable scientists and administrators of science agencies revealed other possible reasons for the transfer, such as, higher salaries for PAEC scientists, a bigger budget for the agency, both of which would have been difficult if PAEC remained under NSDB as its budget and salary structure would have had to be aligned with all other NSDB agencies.[56] PAEC has thus become autonomous. Consequently, policies on research and development on atomic energy for national purposes are now outside the scope of NSDB's science policy.

PAEC is headed by a commissioner and a deputy commissioner appointed by the President. It continues to perform basic and applied nuclear research and development in the areas of food supply, energy and water resources, engineering and industry, medicine, public health and nutri-

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[56]The NSDB Chairman was abroad when the decree was issued and said he had no prior knowledge of the decision to transfer PAEC.

tion, improvement of the environment and radiological surveilance. It has formulated a national atomic energy plan which involves "a total approach considering not only the activities of the Commission but also of other agencies utilizing nuclear techniques either in cooperative projects with PAEC or as recipients of PAEC grants-in-aid."[57] It called the First Philippine Nuclear Congress in 1976, for the purpose of having "more extended discussions and dialogues at the policy ... and operating levels with its present collaborators and those with whom it hopes to set up future linkages."[58] The Congress was attended by representatives of industry, government agencies as well as universities and colleges.

PAEC's service functions include technical assistance to hospitals, industries, universities, research institutions and private individuals in utilizing nuclear energy technology. Examples of these services are irradiation, isotope distribution, industrial process applications of isotopes, radiometric tests, nuclear analyses and repair and calibration of nuclear devices and nucleonic equipment, radio waste management and film badge service. PAEC also performs regulatory functions to ensure public safety and environmental protection. It granted a permit to the National Power Corporation in 1976 to construct the first Philippine Nuclear Power Plant in Bataan,[59] after making several studies and investigations on the project. It has established regulatory guides, codes, standards and criteria for safety in all phases of the establish-

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[57] Republic of the Philippines, Office of the President, Philippine Atomic Energy Commission, Annual Report, 1976 (Quezon City: 25 February 1977, mimeo.), p. 2.

[58] Ibid., p. 9.

[59] Ibid., p. 52.

ment of the Bataan and any future nuclear power plants such as siting, construction of facilities, operations procedures and plant maintenance. It inspects and grants licenses to users and importers of radioactive materials and facilities like medical clinics, hospitals, chemical and medical supply companies, and other factories.

National Pollution Control Commission. Like PAEC,NPCC was removed from NSDB's supervision and control and transferred to the Office of the President in 1976.[60] Unlike the case of PAEC, however, NSDB was consulted and helped prepare the decree reorganizing NPCC.[61] NPCC is headed by a Commissioner and two full-time deputy commissioners, one of whom is responsible for standard-setting and monitoring, and the other for law enforcement. All are appointed by the President.[62] The Commissioner also heads an Inter-Agency Advisory Council which is attached to NPCC. The Council is composed of representatives of the Secretaries of the Departments of Agriculture, Health, Industry, Justice, Labor, Local Government and Community Development, National Defense, Natural Resources, and Public Works, Transportation and Communications; heads of the Laguna Lake Development Authority, National Economic and Development Authority,

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[60]Republic Act No. 3931, 18 June 1964, created the NPCC which was originally designated as the National Water and Air Pollution Control Commission, under the Office of the President. It was renamed NPCC and became an organic agency of NSDB in 1973 as part of the reorganization of the Executive Branch. It was reorganized by Presidential Decree No. 984, 18 August 1976, and returned to the Office of the President. It is now under the Department of Human Settlements as a result of Presidential Decree No. 1396, 2 June 1978.

[61]Interview with the Chairman, National Science Development Board, Metro Manila, 23 March 1977.

[62]The deputy commissioner for standard-setting and monitoring must be a sanitary engineer and the other must be a lawyer. Presidential Decree No. 984, Sec. 3.

National Science Development Board and Human Settlements Commission.[63]

NPCC performs both regulatory and research functions. Presidential Decree No. 984 (Sec. 5) provides that the Commission may conduct scientific experiments and investigations to "discover economical and practical methods of preventing water, air and land pollution." It is entrusted with the preparation of comprehensive annual and long term plans for the abatement and prevention of pollution, in accordance with national development plans. It issues permits for the installation or preparation of sewage works and industrial disposal system and issues standards, rules and regulations to guide city and district engineers in the approval of plans for sewage and industrial waste disposal systems. Moreover, it inspects and investigates factories to determine pollution of air or water. Its research activities include studies on air quality in the Metropolitan Manila Area, the threshold limits and effects of sulphur dioxide on plants, the concentration of pesticides and trace elements toxic to food, fishes, and others. NPCC cooperates with other agencies concerned with environmental pollution such as the Bureau of Mines, Philippine Coast Guard, Petroleum Institute of the Philippines, PAEC and others.

Energy Development Board. Created in 1976, the EDB is composed of seven members: the Secretaries of the Departments of Finance, Industry, Justice, National Defense, Economic Planning, and Natural Resources, and the Chairman of the Philippine National Oil Commission. Among its powers and functions are to:

> a. Formulate policies and implement and coordinate all activities of government relative to the exploration, exploitation, development, and extraction of energy resources including

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[63] Ibid., Sec. 4.

fossil fuels such as petroleum, coal, natural gas and gas liquids; geothermal resources, nuclear fuel resources and other less conventional existing and potential forms of indigenous energy resources.

b. Establish and administer a comprehensive and integrated program for the exploration, exploitation, development, and extraction of fossil and nuclear fuels, geothermal resources, and other less conventional forms of indigenous energy resources.[64]

As can be seen from the membership of EDB, NSDB is not represented despite the fact that its Commission on Volcanology has been actively involved in research and exploration of geothermal and natural gas as energy sources. PAEC is likewise not represented in spite of its concern with nuclear research and the uses of nuclear energy.

Technology Resource Center. Created with NSDB's participation, TRC was set up in 1977. It is designed to provide a link between producers and users of scientific and technological research. The concept underlying TRC was discussed in an international conference of scientists held in Manila in 1976.[65] At the conference, NSDB Vice Chairman Pedro G. Afable delivered a paper pointing out the lack of a policy and regulatory framework for the transfer and development of technology in the Philippines. He recommended that NSDB should be empowered to participate in the evaluation of technology to be imported into the country and in the review of licensing and other agreements. The establishment of TRC was expected to provide an institutional mechanism for this purpose. Some of TRC's functions which are directly related to NSDB's work are:

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[64] Presidential Decree No. 910, 22 March 1976, Sec. 3

[65] Lilia Campo Opeña, "Some Notes on the Theme: Technology and Science Transfer and Utilization," International Conference on the Survival of Humankind: The Philippine Experiment, Panel on Technology and Science Transfer and Utilization (Manila, 5-10 September 1976, mimeo.).

(a) to hasten and enhance social and economic progress in the country, through self-reliance, by rationalizing and systematizing research and development efforts in the light of knowledge already available;

(b) to harness indigenous resources and technologies in the search for improved effectiveness and efficiency of technical activities in the production and service sectors;

x x x

(d) to support and encourage innovative alternatives and approaches to the solution of technical problems, and to broaden options for minimizing future technical problems;

x x x

(f) to link foreign and national research institutions to users through information technology and planning research capabilities; and

(g) to establish a network of permanent coordinating committees on the following areas, but not limited to these: food, population control and distribution, health, nutrition, education, communications, energy, environmental management, science and technology transfer and utilization, housing and urban development, natural disaster prediction, control and moderation, and planning management and decision-making.[66]

TRC's Board of Trustees is chaired by Metropolitan Manila Commission Governor Imelda Romualdez Marcos. Its members include the President of the University of the Philippines; Chairman of the Human Settlements Commission who also serves as TRC's Director General; NSDB Chairman; Secretaries of the Departments of National Defense, Industry, Local Government and Community Development, Public Works, Transportation and Communication, and Natural Resources; NEDA Director General, and Secretary of the Budget Commission. The NSDB Chairman also heads a five-man Executive Committee which administers the TRC's affairs.

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[66] Presidential Decree No. 1097, 23 February 1977, quoted in "Linking Technology to Users," Philippine Development, Vol. V, No. 10 (15 October 1977), p. 28.

As can be seen from the foregoing discussion of other science agencies, NSDB continues to have formal roles in the NPCC and TRC but has no direct links with PAEC and EDB.

Powers and Functions of NSDB

The Science Act of 1958 laid down the powers and functions of the NSDB, of which the following have direct relevance for the education and training of scientists and engineers of the country:[67]

> (1) To coordinate and promote cooperation in the scientific research and development activities of government agencies and private enterprises;
>
> (2) With the approval of the President of the Philippines, to formulate consistent and specific national scientific policies and prepare comprehensive scientific and technological programs which shall be observed and implemented by the Government and all its subdivisions, agencies and instrumentalities;
>
> (3) To establish a system of priorities for scientific and technological projects;
>
> (4) To review and analyze scientific and technological projects, schedule of activities, programs and project proposals, including the progress of projects being undertaken, and to take such measures as may be necessary to accomplish the objectives and policies involved in these activities;
>
> (5) To develop a program for the effective training and utilization of scientific and technological manpower;
>
> (6) To initiate and facilitate arrangements for scientific and technological aid from domestic private sectors and foreign sources and for the exchange of information among local and foreign institutions and scientific investigators;
>
> (7) To offer to, and accept from, public and private sectors, specific project proposals of scientific and/or technological research and development ... and to provide appropriate financial, technical and other support thereto;
>
> (8) To establish and/or provide incentives, including financial and technological support, for the establishment of scientific and technological centers;

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[67] Republic Act No. 2067, Sec. 4.

(9) To disseminate the results of scientific and technological research and to encourage their practical application;

(10) To grant scholarships in mathematics, science, technology and science relating to deserving citizens;

(11) To grant financial or other awards, bonuses and/or prizes to deserving scientific, engineering and technological researchers and inventors;

x x x

(13) To extend travel grants for scientific and/or technological purposes; to send delegates and/or observers to scientific and technological conferences or conventions; and to promote and assist scientific and technological conferences and conventions in the Philippines;

x x x

(15) To undertake, in collaboration with the Department of Education, a thorough survey of the educational system and to determine, as well as to recommend to the corresponding authorities, the measures which may be necessary to make it an effective instrument for scientific advancement;

(16) To initiate and formulate measures designed to promote scientific effort and science consciousness.

Science Policy Formulation and Research Coordination

The NSDB is responsible for setting priorities for the national science development program in line with the goals of national economic plans. It has done this in consultation with members of the scientific community, universities, government officials and representatives of industry. It has sponsored conferences and symposia for this purpose. The first conference especially called for this task was the National Agro-Industrial Research Conference in 1960.[68] The Conference dealt with the identification of priority research problems.

Since 1959, NSDB has sponsored an annual conference to coincide

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[68] UNESCO, National Science Policy and Organization of Research in the Philippines, Science Policy Studies and Documents No. 22 (Paris: UNESCO, 1970), p. 80.

with the celebration of the National Science and Technology Week. During these conferences, which have been attended by officials and scientists from government agencies, universities and colleges and private industry, a review is made of the research activities in various scientific fields. Through these mechanisms, NSDB drew up its "Five-Year Science and Technology Development Program for Fiscal Year 1962-63 to Fiscal Year 1966-67" and its "Science and Technological Research and Development Program for Fiscal Year 1968-69 to Fiscal Year 1972-73."

Following the reorganization of the Executive Branch in 1973, which as we have seen affected NSDB, a Four-Year Development Plan FY 1974-1977 was adopted by the national government. The Plan included a chapter on education and manpower development containing statements on national science policy and NSDB's role. It was the first time that a government plan tried to systematically articulate a national science development program with those of other sectors. The Plan stated:

> The National Science Development Program, of which the NSDB is the chief implementing agency, is geared towards the development of the country's scientific resources for economic, social and cultural progress and the strengthening of the national efforts in agricultural production, industry, resources utilization, public health, housing, technical manpower training, industrial plant development and infrastructure.
>
> Guided by these objectives, the research program is concentrated in activities which aim at increasing the economic utilization of the nation's agricultural and natural resources to meet the expanding needs for basic necessities in life like food, clothing, shelter and also the needs of the economy for vital raw materials and resources of power; upgrading and expanding the nation's export products; economically processing the substantial waste products in agriculture and industry into consumer and export goods; ensuring a reservoir of scientists for the country; and developing public interest and understanding in science and technology.[69]

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[69] Republic of the Philippines, National Economic and Development Authority, Four-Year Development Plan, FY 1974-1977 (Manila: 1973), pp. 327-328.

The Plan indicated that the decision on priorities for scientific research is in accordance with national development goals. The highest priorities are on "those activities that have great bearing upon economic endeavors" such as agricultural development, industrial research on the development of labor-intensive capital goods, improving food supply, narrowing income inequalities and dispersal of technology to rural areas. The development of locally-adopted technology that would utilize the country's natural resources is likewise given high priority. In this connection, the Plan emphasized the need for "radical changes in the educational system, which has been producing potential scientists with Western orientation and training."[70]

There are ten priorities in NSDB's present program of scientific and technological research and development.[71] These are closely geared to national goals enunciated in the Four-Year Development Plan. In line with the first priority, which is increased food production to meet domestic demands and exports, NSDB has always financed agricultural research. The bulk of this research area is now under the responsibility of PCARR which, as we have seen, is an attached agency of NSDB.

The second priority is the expansion of programs for increasing and developing scientific manpower. This is being done mainly through NSDB scholarship and training programs. Third priority is to accelerate efforts to expand the country's export markets by continuing search for new products from local raw materials including those that can be commercially produced by means of labor-intensive cottage industries.

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[70] Ibid., p. 328.

[71] National Science Development Board (Manila: National Media Production Center, 1976), pp. 8-11.

NSDB agencies which are heavily involved in this program are the Philippine Textile Research Institute with its researches in the commercial production of cotton and silk; National Institute of Science and Technology (NIST), through its researches, for example, in developing additional by-products such as chemicals from coconut, and Forest Products Research and Industries Development Commission (FORPRIDECOM) through its research and development activities in wood and wood-based industries.

The fourth priority is the expansion of health care programs to reach a greater number of persons especially in the rural areas. This involves, for example, research on the development of drugs from local herbs and medicinal plants by the Biological Research Center of NIST. NSDB has also supported the University of the Philippines College of Medicine Community Health Clinic in Bay, Laguna and the Botica sa Baryo project which is a study of the feasibility of providing low-cost medicine to rural communities.

The fifth priority in NSDB's program is to provide houses at lower cost. FORPRIDECOM is NSDB's research agency that is involved in this area, testing and developing houses made out of indigenous materials. NIST is also engaged in teaching individuals in the rural areas to make bricks and ceramics out of local clay.

The search for areas where government may assist the private sector in the development, growth and expansion of local factories is sixth priority in NSDB's program. NSDB agencies concerned with this scientific activity are FORPRIDECOM with the wood-based industries as its focus, PTRI which is closely linked with the textile industry, NIST through its researches on the improvement of local pottery and technical assistance to the ceramic industry, and MIRDC which trains workers for factories involved in the progressive car manufacturing program.[72]

Support for government programs to set up infrastructure like roads, bridges, ports, airports and railroads, is seventh in NSDB's priorities. NSDB has allocated research funds to develop aircraft for interisland use. FORPRIDECOM has similarly undertaken research to identify species of trees which could be used for railroad ties, and research to chemically treat coconut trunks to make them suitable as electric posts and building materials.

The eighth priority is in social welfare and community development. Researches in this area are aimed at achieving a better quality of life, especially in rural areas. NSDB's Food and Nutrition Research Institute is involved in developing new food supplements, particularly those high in protein content, and research on the nutritive value of local diets in order to improve general nutrition of the population.

The preservation of the country's wildlife and other similar projects that would support the country's tourism program is ninth in NSDB's list. Tenth priority is the continuing search for alternative sources of energy including more extensive sources of oil and uranium in the country. NSDB has pioneered in the planning and development of atomic energy and geothermal plants. The first demonstration geothermal plant set up by NSDB's Commission on Volcanology is being commercially developed by the National Power Corporation to supply electricity for the Bicol region and adjacent areas.

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[72]The progressive car manufacturing program started in 1973 and is regulated by the Board of Investments. It is "progressive" in the sense that it aims to increase the use of locally available materials each program year. See Department of Public Information, The Economy of the Philippines, Philippine Briefings, No. 2 (January 1975), pp. 17-18.

Research and development within these priorities are guided by the goals set in the Four-Year Development Plan. As articulated by NSDB, these are: (1) increasing the economic utilization of agricultural and natural resources to adequately meet the needs of a growing population; (2) upgrading and expanding the nation's export products to improve its foreign exchange position and consequently the national economy; (3) economically processing waste products in agriculture and industry into dollar-saving consumer goods and dollar-earning export commodities; and (4) insuring for agriculture, industry, educational institutions and government agencies, a reservoir of competent scientists and technologists.[73]

NSDB's Research and Development program covers projects in agriculture and natural resources, industry and engineering, medicine and allied sciences, food and nutrition, social sciences and development of inventions. NSDB uses financial grants to support these projects. These grants are extended to institutions as well as individual researchers.

Financing Scientific Research and Development

Since its establishment in 1959, NSDB's major problem in implementing its scientific research and development program has been the paucity of government appropriations both for the operation of its agencies as well as for other institutions doing scientific work. This was a major finding of the Senate Committee on Scientific Advancement in 1962 when it conducted public hearings on the problems of science. Testimonies given by the NSDB Chairman, the Secretaries of the Departments of Agriculture and Natural Resources and Health, Directors of the Bureaus of Animal Industry, Plant Industry, Soils, Fisheries, Mines, Forestry and Weather Bureau, pointed to the meager government financing of scientific

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[73] National Science Development Board, op. cit., p.11.

activities. Regional directors of these offices gave similar evidence before the Committee. They pointed to the low appropriations and slow release of funds for their agencies which prevented their acquisition of much needed laboratory/office equipment, technical references, books and periodicals. Consequently, researches were often not completed or worse, not even started at all, and scientific personnel were, it was said, underpaid and demoralized.[74]

As a result of the hearings, there was an attempt to find ways of increasing government funding for science. This culminated in the enactment of the Special Science Fund Law by Congress in 1968.[75] The Special Science Fund was to be derived from the imposition of an additional tax on privately-owned passenger automobiles, motorcycles and scooters and from the proceeds of a science stamp tax imposed on tax clearance certificates of Filipinos travelling abroad. These taxes collected by the Bureau of Internal Revenue and Land Transportation Commission were to be turned over to the National Treasurer to be used solely "to promote scientific and technological research and development, foster inventions, and utilize scientific knowledge as an effective instrument for the promotion of national progress."[76] The Act gave the NSDB power to allocate the fund when it specified that

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[74] Republic of the Philippines, Congress, Senate, Committee on Scientific Advancement, Report on the Problems of Science in the Philippines (Manila: National Science Development Board, 1963), pp. 4-19.

[75] Republic Act No. 5448, 25 September 1968, as amended by Republic Act No. 5470, 30 May 1969.

[76] Republic Act No. 5448, Sec. 1, enumerates the following agencies as beneficiaries of the Special Science Fund: NSDB and its agencies, National Research Council of the Philippines, Science Foundation of the Philippines (both of which are now attached agencies of NSDB, but not at that time), University of the Philippines and Bureaus of the Department of Agriculture and Natural Resources.

> It shall be the ministerial duty of the Budget Commissioner and the National Treasurer, as well as of the officers and employees under their supervision and control, to effect releases from the Fund upon order and/or authorization of the Chairman of the National Science Development Board, on recommendation by the agencies under the National Science Development Board, or of the Chairman of the National Research Council of the Philippines as the case may be.[77]

The salutary effect of the Special Science Fund Law on appropriations for NSDB and its agencies can be seen in Table VI-2. For fiscal years 1958-59 to 1962-63, NSDB and its agencies received an aggregate of ₱31.788 million as appropriations from the General Fund.[78] The average annual appropriations during the first five years of NSDB's operations was ₱6.358 million. For FYs 1963-64 to 1968-69, NSDB's total appropriations reached ₱50.837 million, or an annual average of ₱8.473 million during this six-year period. This represented an increase of 33.3 per cent in average annual appropriations compared with the previous five years. For FYs 1969-70 to 1972-73, NSDB's appropriations from the General Fund totaled ₱62.608 million or an average annual appropriation of ₱15.652 million in this four-year period. This was greatly augmented by the Special Science Fund which amounted to ₱152.853 million or an annual average of ₱38.213 million in additional appropriations.

It will be noted that NSDB's total appropriations for FY 1972-73, from both General Fund and Special Science Fund, was nearly 12 times its appropriations in FY 1958-59. In real terms, however, NSDB's annual appropriations has not really increased that much. This is

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[77] *Ibid.*, Sec. 5.

[78] The fiscal year began on 1 July and ended on 30 June of the following year.

Table VI-2
Appropriations for NSDB and Its Agencies
By Source of Funds and as Proportion of National Expenditures
FYs 1958-59 to 1972-73 (In Million Pesos)

Fiscal Year	Appropriations for NSDB and Its Agencies			National Government Expenditures*	NSDB Total as Per Cent of National Total
	General Fund	Special Fund	Total		
1958-59	₱ 5.045	-	₱ 5.045	₱ 1,012	0.5%
1959-60	5.258	-	5.258	1,196	0.4
1960-61	6.386	-	6.386	1,411	0.5
1961-62	7.383	-	7.383	1,469	0.5
1962-63	7.716	-	7.716	1,852	0.4
1963-64	8.179	-	8.179	2,067	0.4
1964-65	8.435	-	8.435	2,077	0.4
1965-66	8.206	-	8.206	2,228	0.4
1966-67	8.266	-	8.266	2,531	0.3
1967-68	8.441	-	8.441	2,944	0.3
1968-69	9.311	-	9.311	3,611	0.3
1969-70	10.594	₱34.691	45.285	4,053	1.1
1970-71	15.003	38.080	53.083	4,429	1.2
1971-72	17.772	39.518	57.320	5,588	1.0
1972-73	19.238	40.564	59.803	7,941	0.8

Sources of Data: Republic of the Philippines, National Science Development Board, Science and Technology: Key to National Progress (Manila: 1972), p. 5; National Economic and Development Authority, 1977 Philippine Statistical Yearbook, Tables 11.2 and 11.3, pp. 456-459.

*Totals for National Government Expenditures include General Fund only.

From 1959 to 1961, official exchange rate was ₱2 to US $1; from 1962 to 1969, it was ₱3.90 to US $1; and since 1970, the rate has floated between ₱6.70-₱6.76 to US $1. See Romeo M. Bautista, "Inflation in the Philippines, 1955-1974," in Jose Encarnacion, Jr. et al, Philippine Economic Problems in Perspective (Quezon City: University of the Philippines, School of Economics, Institute of Economic Development and Research, 1976), pp.190-191.

because the peso was devalued by 72 per cent when the government adopted a floating exchange rate in February 1970.[79] Considering that much of the laboratory equipment for scientific research, scientific/technical journals and other materials are imported into the country, this has shrunk NSDB's allocations for research and development.

As a proportion of total national government expenditures, NSDB appropriations, with the exception of those for FYs 1969-70 to 1971-72, remained below one per cent. In terms of percentage of the GNP being expended on research and development, NSDB's expenditures was only 0.1 per cent in 1960-61.[80] In comparison with some Asian countries, the Philippines ranked ninth in 1968, spending 0.22 per cent of its GNP for research and development. The other countries, with their respective expenditures for research and development as a percentage of GNP, were: Japan, 1.2 per cent; Thailand, 1.04 per cent; Iran, 0.45 per cent; Republic of China, 0.39 per cent; Ceylon (now Sri Lanka), 0.35 per cent; India, 0.34 per cent; Republic of Korea, 0.28 per cent; Pakistan, 0.27 per cent; Nepal, 0.14 per cent; Singapore, 0.05 per cent; and Cambodia, 0.01 per cent.[81]

Among OECD countries, expenditures on research and development as

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[79] Romeo M. Bautista, "Inflation in the Philippines, 1955-1974," in Jose Encarnacion, Jr. et al, Philippine Economic Problems in Perspective (Quezon City: University of the Philippines, School of Economics, Institute of Economic Development and Research, 1976), pp. 190-191.

[80] Gregorio Y. Zara, "Research in the Philippines: Accomplishments and Problems," The Philippine Economy Bulletin, Vol. V, No. 3 (1967), p. 27.

[81] UNESCO, Basic Data and Considerations for the Conference on the Application of Science and Technology to the Development of Asia (Paris: 1968) cited in Juan Salcedo, Jr., "Industrial Research: An Imperative of Economic Progress," Science Review, Vol. X, No. 1 (January 1969), p. 8.

a percentage of GNP showed the following pattern in 1969: United States, 2.81 per cent; Great Britain, 2.22 per cent; France, 1.78 per cent; Canada, 1.34 per cent; Belgium, 1.14 per cent; Norway, 0.99 per cent; Italy, 0.85 per cent; and Greece, 0.18 per cent.[82]

For FYs 1970-71 to 1972-73, total appropriations for NSDB and its agencies has remained 0.1 per cent of total expenditures on GNP.[83]

Scientific Manpower Development Program

The NSDB has, since its establishment, placed a high priority on formulating a program for increasing and developing the country's stock of scientific and technological manpower. This is one of its major functions specified by the Science Act of 1958. The importance given to this by NSDB can be seen in the proportion of grants-in-aid that it has allocated in the past for projects in scientific manpower development. Out of its total appropriations for FYs 1958-59 to 1964-65 (₱48,402,569), NSDB allotted ₱12,055,480 for grants-in-aid for research and development programs. Of this amount, 32.2 per cent (₱4,241,795) were for manpower development projects. For FYs 1965-66 to 1971-72, the amount spent for grants-in-aid for research and development rose to ₱21,464,053, an increase of 78 per cent over the previous seven-year period. Of this total, 49 per cent (₱10,511,600) was spent for manpower development programs. Grants-in-aid for research and development in

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[82] Available data for Germany and Denmark were for 1967 only. Research and development expenditures for these two countries were 1.71 per cent and 0.74 per cent, respectively, of their GNP. See Science Council of Canada, Policy Objectives for Basic Research in Canada, Report No. 18 (Ottawa: September 1972), Table 2, pp. 62-63.

[83] This was GNP at constant prices of 1972. Expenditures on GNP were as follows: 1971, ₱52,921 million; 1972, ₱55,526 million; and 1973, ₱60,881 million. See 1977 Philippine Statistical Yearbook, op. cit., Table 4.6,pp.124-125.

Table VI-3
NSDB Grants-in-Aid for Research and Development
By Area of Research, FYs 1958-59 to 1964-65 and 1965-66 to 1971-72

Area of Research	Fiscal Year 1958-59 to 1964-65		
	Amount Granted	Per Cent Distribution	Average Amount/Yr.
Manpower Training	₱ 4,249,795	35.2	₱ 607,114
Agriculture and Natural Resources	2,406,269	20.0	343,753
Engineering, Industry and Trade	2,158,711	17.9	308,387
Medicine and Allied Sciences	429,171	3.6	61,310
Food and Nutrition	762,736	6.3	108,962
Social Sciences	471,130	3.9	67,304
Basic Research	1,577,668	13.1	225,381
Total Grants-in-Aid	₱12,055,480	100.0	₱1,722,211
Total NSDB Appropriations	₱48,402,569	-	₱6,914,653
Total Grants-in-Aid as per cent of Total NSDB Appropriations	24.9%		

Area of Research	Fiscal Years 1965-66 to 1971-72			
	Amount Granted	Per Cent: Distri- bution	Average Amount/Yr.	% Increase FYs 1958-59-1964-65 to FYs 1965-66-1971-72
Manpower Training	₱10,511,600	49.0	₱ 1,501,657	147.3
Agriculture and Natural Resources	4,927,101	23.0	703,872	104.8
Engineering, Industry and Trade	3,223,504	15.0	460,500	49.3
Medicine and Allied Sciences	729,556	3.4	104,222	70.0
Food and Nutrition	471,318	2.2	67,331	- 38.2
Social Sciences	1,448,004	6.7	206,858	207.3
Basic Research	152,970	0.7	21,853	- 90.3
Total Grants-in-Aid	₱21,464,053	100.0	₱ 3,066,293	78.0
Total NSDB Appropriations	₱189,911,982	–	28,778,875	-
Total Grants-in-Aid as per cent of Total NSDB Appropriations	11.3%			

Source of Data: Republic of the Philippines, National Science Development Board, Science and Technology: Key to National Progress (Manila: 1972), pp. 5, 9.

agriculture and natural resources ranked second to those spent for manpower development programs. Table VI-3 shows NSDB's appropriations for research and development, by area of research for FYs 1958-59 to 1964-65 and 1965-66 to 1971-72.

NSDB's scientific manpower development program is made up of the science scholarship program, science education and other training programs, and agency staff development programs. The science scholarship program covers both undergraduate and graduate studies. The undergraduate science scholarships began in June 1958 as the "Science Talent Search" project administered jointly by the Science Foundation of the Philippines and Board of National Education. Authority for this project came from Republic Act No. 1606 which created NSDB's predecessor, i.e. the National Science Board. The project was implemented by written examinations and oral interviews administered to the top ten per cent of graduates of all secondary schools by screening committees consisting of local school officials. Successful applicants were given scholarships covering tuition fees, book allowances and monthly stipends to enable them to complete collegiate courses in the physical or biological sciences and the teaching of science. As long as a grantee maintained a grade average in the sciences and mathematics (and no failing marks in other courses), the scholarships were renewed until the course was completed. To enhance their training in science, grantees were required to serve in the NSB's research projects which are in line with their respective fields of study.[84] In exchange for govern-

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[84] "Rules for the Science Talent Search Scholarships," Department of Education, General Educational Policies, A Report of the Board of National Education, 1958 (Quezon City: Bookman, 1960), pp. 34-35.

ment support for their studies, grantees were required to serve the government upon the completion of their courses, equivalent to the length of time that they enjoyed the scholarships.

The Science Talent Search project was taken over by NSDB soon after it was established. It has been known since then as the NSDB Undergraduate Science Scholarship Program. It is presently administered by the General Committee on the Selection and Guidance of Scholars chaired by the Chief of NSDB's Education and Training Division. The fields of study, number of slots, rules and regulations regarding the program are determined by this Committee and submitted to NSDB's Board of Governors for approval. As much as possible,fields of study emphasized have taken into account the national government's programs. This was the case with the five-year science and technology program of former NSDB Chairman Juan Salcedo, Jr. which was geared to President Macapagal's "Five-Year Integrated Socio-Economic Development Program."[85] The present priorities in NSDB's manpower training program are in consonance with those laid down for the national economy by the National Economic and Development Authority as well as those of the National Manpower and Youth Council (NMYC).[86]

For academic years 1958-59 to 1976-77, NSDB has awarded a total of 1,054 scholarships. As of the start of the second semester of academic year 1975-76, 29 per cent had graduated with Bachelor's degrees in

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[85] This was for fiscal years 1962-63 to 1966-67. See Soledad L. Antiola, "Wanted: A Realistic Approach to the Determination of a Science Scholar's Field of Study," Science Review, Vol. 5, Nos. 11-12 (November-December 1964), p. 10.

[86] The NMYC is an interdepartmental agency headed by the Secretary of Labor. The NSDB Chairman is a member of NMYC. Interview with the NSDB Chairman, Metro Manila, 16 March 1977.

the sciences and engineering. The number of dropouts from the program has been quite high, 44 per cent (469), during the above period. Causes for dropping out include poor academic performance (failing grades and academic underload), voluntary withdrawal, poor health and death. NSDB has, therefore, been studying ways of improving its selection of scholarship grantees and their guidance into priority science fields.[87]

Starting in academic year 1961-62, NSDB has financed a graduate scholarship program in the sciences. The awards were originally for studies in local as well as foreign universities. Because of the government's policy of restricting dollar remittances, however, foreign slots were suspended at the end of fiscal year 1971-72. The scholarships are now only for studies in local universities and is administered by the NSDB-UP Graduate Manpower Program. Most of the grantees go to the University of the Philippines for their training. As of academic year 1975-76, a total of 252 graduate scholarships at the master's level and 12 at the Ph.D. level had been awarded.[88] Of this number, 37 per cent (93) of M.S. grantees and 16.7 per cent (2) of Ph.D. grantees have completed their degrees.

Of 34 awardees of foreign graduate scholarships from 1961 to 1971, 16 were graduated by fiscal year 1971-72. Most of these were employed in government agencies, colleges and universities. Three were reportedly

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[87]A grantee's field of study is determined by a combination of personal preference, aptitude and priority fields indicated by NSDB. See Antiola, <u>op. cit</u>., pp. 5-9.

[88]An additional 33 scholarships were granted for academic year 1976-77 bringing the total number of graduate scholarships to 297. The data, however, do not provide a breakdown of the 33 additional grants into M.S. or Ph.D. Data taken from Education and Training Division, National Science Development Board, February 1977.

employed abroad.[89]

The graduate scholarships cover tuition, books and stipend. Moreover, NSDB also grants thesis research awards. From academic year 1968-69 until the first semester of academic year 1976-77, it has granted a total of 102 thesis awards for both M.S. and Ph.D. students enrolled in public and private colleges and universities in the Philippines. Of this number, 97 were in the natural sciences and engineering and five were in the social sciences.[90]

A third aspect of NSDB's scholarship program is for the development of its own qualified and deserving staff members and those of its agencies. Scholarships are granted to personnel to enable them to pursue Master's or Ph.D. degrees in the natural sciences, engineering and social sciences like in public administration and economics. This program started in 1970-71 under Policy Instructions No. 5.3, issued by the Board of Governors. As of the end of academic year 1975-76, a total of 81 staff members of NSDB and its agencies had been awarded scholarships (including 11 from the Philippine Atomic Energy Commission before its transfer to the Office of the President in 1974). The NSDB, FORPRIDECOM and NIST, have had the most number of grantees, 56 or 69 per cent of the total.

PCARR launched its own manpower development program in 1973. Scholarships have been granted for the B.S. in fisheries, Master's and Ph.D. degrees in agriculture and forestry. These are tenable in local

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[89] Republic of the Philippines, National Science Development Board, <u>Annual Report for Fiscal Year 1971-72</u> (Taguig, Rizal: 1972), p. 214.

[90] Statistics were provided by the Education and Training Division, National Science Development Board, February 1977. The thesis awards provide financial aid not to exceed ₱1,000 per grantee. For academic year 1977-78, NSDB allocated ₱50,000 for this purpose. See "NSDB Thesis Grants Open," <u>U.P. Newsletter</u>, Vol. V, No. 4 (31 January 1977), p. 7.

colleges and universities, particularly the University of the Philippines at Los Baños, the U.P. College of Fisheries and College of Arts and Sciences. PCARR likewise grants thesis research awards which have mostly been for students at U.P. at Los Baños. Most of PCARR's grantees are faculty members of state-supported agricultural colleges and staff members of government research agencies for specific commodities. At the beginning of academic year 1976-77, PCARR had a total of 196 graduate and 22 B.S. in Fisheries grantees.[91] Eight of the graduate grantees finished their master's degrees in December 1976.[92] PCARR's target for its manpower development program is 335 Ph.D. holders, 924 with M.S. degrees and 480 more with B.S. in Fisheries.

PCARR also finances graduate research for theses which fall within the national research priorities set up by its national commodity research teams. As of August 1976, 26 students at the University of the Philippines at Los Baños doing graduate research studies have been supported through the PCARR Graduate Research Grant which began in October 1975.[93]

In 1976, the National Research Council of the Philippines similarly started giving financial assistance to graduate researchers for their M.A. and Ph.D. theses, a grant of ₱3,000 for each M.A. thesis and ₱6,000 for each doctoral dissertation. A total of four grants under this program were made during 1976 for students in state colleges and

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[91] "Massive Research Manpower Development Program in Full Swing," Monitor, Vol. IV, No. 6 (June 1976), pp. 1, 2.

[92] "Eight PCARR Scholars Finish Studies," Monitor, Vol. IV, No. 12 (December 1976), pp. 11, 2.

[93] "More UPLB Grad Students Get PCARR Support," Monitor, Vol. IV, No. 8 (August 1976), p. 15.

universities totaling, ₱14,550.[94]

The Philippine Science High School is the attached agency of NSDB which awards scholarships for secondary students. The PSHS is assisted by NSDB through its share of the Special Science Fund. As a follow-up of PSHS efforts to train a core of future scientists for the country, NSDB has funded an Integrated Academic Program in the Sciences (INTAPS) since July 1974 at the College of Sciences and Humanities, University of the Philippines at Los Baños. The INTAPS Program grants scholarships to PSHS graduates to enable them to have an accelerated training in the sciences at the UPLB. The awards consist of monthly stipend, school fees and book allowances. Graduates of other secondary schools can be admitted to the INTAPS Program, provided they belong to the top 25 per cent of successful examinees of the U.P. College Admissions Test, but they do not qualify for the scholarship award. Participants of INTAPS can move into higher science and other courses through a system of accreditation whereby courses which they had taken in their secondary program are given university credits. The INTAPS curriculum is thus flexible and allows a participant to finish the B.S. degree in three years instead of the usual four years.[95]

Since 1976, NSDB has been studying the feasibility of establishing regional science high schools in order to provide relevant training for more students who would be interested and qualified to pursue science careers.

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[94] National Research Council of the Philippines, Annual Report, 1976, op. cit., p. 11.

[95] "21 Qualify as INTAPS Scholars," New Horizons, Vol. I, No. 1 (September 1979), p.11.

All agencies of NSDB, organic as well as attached, conduct short-term training programs as part of their manpower development activities and service functions. The NSDB itself has concentrated its support for training programs aimed at improving the quality of science education at all levels of the educational system. Since 1971, it has financed Summer Science Institutes for elementary and secondary school teachers in mathematics and the sciences. These have been held at the Regional Science Training Centers (RSTCs) for six weeks in May and June. In the summer of 1972 alone, a total of 615 secondary science teachers were trained in five RSTCs. Table VI-4 shows the field of training and participants in the NSDB-sponsored Summer Science Institutes for high school teachers in 1972.

Table VI-4
Secondary School Teachers Trained at the
NSDB-Sponsored Summer Science Institutes, 1972

Training Centers	Total No. of Participants	Fields of Training: Physics	Chemistry	General Science	Biology	Mathematics
Silliman University	124	25	23	25	26	25
Notre Dame of Marbel	124	25	24	25	25	25
Aquinas University	120	25	22	25	23	25
St. Louis University	125	25	25	25	25	25
Ateneo de Davao	122	24	23	25	25	25
Total	615	124	117	125	124	125

Source of Data: Republic of the Philippines, National Science Development Board, Annual Report for Fiscal Year 1971-72 (Taguig, Rizal: 1972), p. 209.

In addition to high school teachers trained in the RSTCs, 30 teachers from public and private elementary schools attended a summer institute at the Zamboanga State College in 1972. In 1971, NSDB also started financing a graduate training program for college instructors of physics in the Mindanao-Sulu-Palawan region. At the end of FY 1971-72, 25 grantees graduated under the program and subsequently returned to their respective schools.

Among NSDB's organic agencies, NIST, through its Scientific Instrumentation Division, conducts three-year training program in electronics, fine mechanics, scientific glassblowing and optics. Of 16 trainees who started in 1973, ten completed the program. Nine of the graduates had found employment at the end of 1976.[96] The Chemical Research Department also implemented the Science Technology Laboratory Training for NSDB scholarship grantees from 1 April to 14 May 1976.

FORPRIDECOM similarly undertakes a number of short-term manpower development and training programs for wood-based industries, government agencies and educational institutions. Some ten seminars/training sessions on technical subjects as wood seasoning, pole preservation, pulp and paper analysis, and others were held from July 1975 to June 1976.[97]

Role of NSDB and Agencies in Policy Formulation on Scientific Education, Training and Research

Before the Reorganization of the Executive Branch in 1973, decisions about scientific research and development as well as scientific manpower

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[96] Republic of the Philippines, National Science Development Board, National Institute of Science and Technology, The NIST Report, July 1975-December 1976 (Manila: December 1976), p. 167.

[97] Forest Products Research and Industries Development Commission, Annual Report, 1975-76, op. cit., Appendix cc.

development were made by NSDB and institutions under its supervision. These decisions were made at the level of NSDB's Board of Governors. At that time, the Board was made up of the NSDB Chairman, Vice Chairman, heads of such agencies as NIST, PAEC, NRCP and FORPRIDECOM, Director of the Office of National Planning of the National Economic Council, Vice President for Academic Affairs of the University of the Philippines and four other members representing industry, education, scientific and technological societies and agriculture.[98]

Under the previous organizational setup, heads of NSDB agencies were thus able to participate in decision-making on research priorities, the science scholarship program as well as on the allocation of the Special Fund for other scientific activities. These agencies received lump sum appropriations from the Special Science Fund and were also eligible to apply for grants-in-aid for specific research projects. Their direct participation in decision-making at NSDB's Board of Governors was, therefore, a source of discontent among other government research agencies. The Technical Panel which surveyed the national agricultural research system in 1970 observed:

> This situation is eyed with suspicion by non-NSDB research agencies because the heads of NIST, PAEC and FORPRIDECOM are members of the Governing Board which approves projects to be funded. This suspicion is further aggravated by the fact that research project proposals sometimes take about two years before it (sic) could be funded. The latter situation is brought about by the lack of an effective mechanism to determine priority research projects. All of these have brought about a situation where some practical research agencies would like to put themselves under NSDB to have direct access to NSDB funds.[99]

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[98] The last four positions were vacant in FYs 1969-70 and 1971-72. See Republic of the Philippines, National Science Development Board, Annual Report for Fiscal Year 1969-70 (Quezon City: December 1970), p. 1 and Annual Report for Fiscal Year 1971-72, p. 1.

[99] National Agricultural Research System Survey, Technical Panel, op. cit., p. 73.

As a result of this discontent, and the Reorganization of 1973 (see p. 253),the role of NSDB agencies in the formulation of policies affecting scientific research and science education has now become largely indirect. Heads of these agencies no longer sit as members of NSDB's Board of Governors. Any inputs they have on science policy decisions are now made during their regular meetings with the NSDB Chairman and Vice Chairman. These policies are subject to confirmation by the Board of Governors.

The importance given by the government to the formulation of science policy for the country, particularly on scientific and technological manpower development is reflected in the present composition of the NSDB Board of Governors. The education sector is now directly represented on the Board by the Secretary of Education and Culture and President of the University of the Philippines. Moreover, the President of the Philippines can appoint one of the two other members of the Board to represent education, although he has not done so. Furthermore, the NSDB Chairman has been made a member of the National Board of Education (NBE) as a result of the 1973 Reorganization. The NBE is responsible for the formulation of the country's general education objectives, policies and long-range education plans.

The present membership of NSDB's Board of Governors should now provide for a better coordination of science policy formulation with educational planning and policy formulation through the presence on the Board of the Secretary of the Department of Education and Culture and NSDB Chairman who is also a member of the National Board of Education. It should also assure the integration of science and educational policy with overall government economic policies and programs. This is because the Board now counts as one of its members the Director General of the

National Economic and Development Authority which is the highest economic planning body. The linkages between national economic policy, science and technology policy and educational policy have, therefore, been reinforced in the existing membership of NSDB's policy-making body.

Scientific, Professional Associations and NSDB Policy-Making on Scientific Education, Training and Research

Scientific and professional associations have not had any regular contribution to NSDB policies on scientific education, training and research. The Science Act of 1958 provided for one representative of scientific and technological societies on the NSDB Board of Governors to be appointed by the President of the Philippines. However, as mentioned above, the position was vacant for some time. In the reorganized Board of Governors, this position has been abolished. NSDB has nevertheless maintained close links with some of these associations through the active membership of its staff in these organizations. As discussed in Chapter IV, incumbent administrators of government science agencies such as, for example, NSDB and NIST, have generally been elected as officers of the Philippine Association for the Advancement of Science (PhilAAS). Because of cross membership in scientific societies, officers and members of PhilAAS have often been officers and members of other specialized associations. A direct contribution of PhilAAS to science education policy was the creation of the Philippine Science High School in 1963. This was one of the topics discussed in the 1960 PhilAAS convention and became the basis of a PhilAAS resolution addressed to the

President of the Philippines, endorsing the PSHS establishment.[100]

NSDB has tried to establish more formal linkages and regular dialogues with scientific and technological societies in the country. In April 1973, the NSDB Chairman issued a special order to create a special project on the establishment of a Center for Scientific and Technological Organizations (CSTO) within the NSDB Science Community.[101] The CSTO was to house the offices of these organizations, provide secretariat services for them as well as serve as a conference site. Thus it was expected to provide a permanent liaison between the scientific and technological societies, government agencies, and industry, to bring about closer collaboration between these sectors in the advancement of science and technology and their utilization to solve national problems.

The concept of CSTO was inspired by the Clunies Ross (Memorial) House, National Science Center in Australia,which contains the offices of 33 scientific/technological societies. The operation of Clunies Rose (Memorial) House had been observed by the Chief of NSDB's International Relations Division while serving as Science Attache to Australia from

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[100]Philippine Association for the Advancement of Science, <u>25th Anniversary Convention Souvenir Program</u> (Manila: 27-29 October 1976), p. 24. The subject was discussed in the convention by Dr. Leopoldo V. Toralballa, a Filipino professor of mathematics in New York University and member of the Board of Directors of the American-Philippine Science Foundation,Inc. The latter is a private nonprofit organization which was established to solicit funds for science scholarships in the Philippines. The idea of a Philippine Science High School was apparently based on the example of Bronx Science High School in New York City.

[101]National Science Development Board, Special Project No. 7306 OT, 23 April 1973.

1967 to 1971.[102] A similar proposal for the establishment of a Canadian House of Science, Engineering and Technology was made by the SCITEC Management Committee in 1972 "in order to provide facilities for greater economy and effectiveness of Canadian national science-based societies."[103]

Regular monthly meetings between representatives of the scientific and technological societies, Council of Organizations on Technology and Allied Sciences of the Philippines (COTASP), CSTO project director and representatives of private industry took place from 1973 to 1975 to plan the establishment of the Center. There was already an architectural plan for its building which was prepared by COTASP.[104] The NSDB Chairman had already designated a lot for the building and allocated funds for its construction. The national government, however, imposed a ban on the construction of public buildings and infrastructures in 1975.[105] Because of this, the project had to be temporarily shelved. Soon after the project was suspended, the incumbent Chairman's term of office expired and a new Chairman was appointed by the President. Under the new Chairman,

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[102] Interview with Mr. Silvestre Javier, Chief, International Relations Division and Project Director of the Center for Scientific and Technological Organizations, National Science Development Board, Metro Manila, 20 July 1977. Clunies Ross (Memorial) House is located near the University of Victoria, Melbourne, Australia.

[103] Management Committee of SCITEC and Allen S. West, National Engineering, Scientific and Technological Societies of Canada, Science Council of Canada, Special Study No. 25 (Ottawa: December 1972), pp. 11-12.

[104] The Philippine Institute of Civil Engineers (PICE) actively participated in planning the construction of the proposed CSTO building. At that time, a director of PICE (Angel Lazaro, Jr.) was also head of COTASP. See "₱3-M Science, Technology Complex to be Constructed," Philippines Daily Express, 13 May 1974, p. 15.

[105] Interview with former NSDB chairman, Florencio Medina, National Research Council of the Philippines, Metro Manila, 8 March 1977.

the CSTO project has not received the initial support that launched it. Consequently, the liaison that it started has been weakened.

Policy-Making for Scientific Education and Training: Analysis

It is too early to assess the effectiveness of the reorganized decision-making setup at NSDB. Suffice it to say that there are many factors which hinder effective policy-making for scientific education and training in the country. For one thing, effective integration and coordination of programs for scientific research and development is hamstrung by the presence of government research agencies that are beyond the aegis of NSDB, for example, the Forest Research Institute of the Department of Natural Resources, Philippine Atomic Energy Commission, National Pollution Control Commission, and others. NSDB's influence on these agencies is indirect, only in so far as they are recipients of its grants-in-aid for research projects.

There are several agencies that are concerned with decision-making for higher education as well as manpower development such as the Department of Education and Culture, Professional Regulation Commission and its examining boards, and chartered state universities and colleges. These institutions make decisions about curricula and qualifications of professional scientists and engineers. Compared to these, NSDB's policies affecting the education and training of scientists and engineers are primarily aimed at stimulating individuals to take up these careers.

NSDB was authorized by the Science Act of 1958 to make studies on supply and demand for scientific and technological manpower in the country. On the basis of these studies, NSDB was to grant scholarships for science and engineering to ensure an adequate supply of these personnel. During its existence, however, NSDB has not been able to make a regular and continuous assessment of the country's stock of scientific and technological manpower which should be the basis for estimating the future needs of government, universities/colleges and industry. As shown in Chapter V, so far, only one comprehensive survey has been sponsored by NSDB. By the time the results of the sectoral surveys were published, the figures had become outdated. Consequently, NSDB's policies for scientific and technological manpower development have not been supported by more concrete and up-to-date information on supply and demand for scientific manpower. There are no available statistics, for example, showing the current number of scientists in government by fields of specialization, positions and functions, nor estimates of their turnover. Similarly, there is no adequate information on the number of scientists in industry and areas of research that they are currently engaged in. In this regard, PCARR is ahead of NSDB as it has been doing a regular survey of scientists engaged in agricultural and resources research on which to base targets for its scientific manpower development program. PCARR's work is, to a certain extent, simplified by its more specialized area of concern on agriculture and resources research. The NSDB's focus covers all the sciences.

NSDB has not been able to influence the professional examining boards, for example, in terms of what should be the relevant training for the professional scientists and engineers of the country. Professional examining boards have no formal links or liaison with NSDB. Specialized professional associations of scientists and engineers in turn have not had any regular contribution to NSDB's function of determining supply and demand of the country's scientific and technological manpower.

In general, NSDB has had to compete with the Department of Education and Culture for the overall share of national funds for higher education and training of manpower. The Department of Education and

Culture administers the State Scholarship Program which began in 1969.[106] The scholarships are granted annually by the National Scholarship Center to poor but deserving students in the field of science, arts and letters. From 1969 to 1976-77, there have been 1,513 national and local state scholars in private and government colleges and universities. The courses pursued by the awardees are determined by their personal preferences or by the results of their aptitude tests in such areas as English, mathematics, science and social sciences.[107] In one sense, the State Scholarship Program under the Department of Education and Culture and those of the NSDB have different priorities, though not necessarily exclusive of each other, i.e. democratizing higher education versus excellence or quality in higher education which is demanded by the nature of scientific education and training.

On the whole, NSDB's efforts in ensuring an adequate supply of highly-trained scientific and technological manpower for the country, like its scholarship and training programs, have produced little effect in the context of overall enrollment patterns in the sciences. The number of students in science programs has remained small, especially at the graduate level. Given this situation, there have been attempts to reexamine the country's science policy or the lack of it. This has been a prominent concern of government especially in the light of efforts to accelerate industrialization and economic development.

To a certain extent consciousness of the need for a comprehensive science policy in the Philippines seems to have been influenced by UNESCO's views and activities, some of which were discussed in Chapter I.

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[106] Republic Act No. 4090, 19 June 1964.

[107] "Government Scholarships: Democratizing Education," Philippine Development, Vol. IV, No. 22 (15 April 1977), pp. 14-16.

The Philippines was represented in the United Nations Conference on Science and Technology for Development in 1963 and in the 1968 UNESCO Conference on the Application of Science and Technology to the Development of Asia. Moreover, in 1969, NSDB coordinated a task force which prepared a report on National Science Policy and Organization of Research in the Philippines for UNESCO.[108] Although the report was largely a descriptive, institutional analysis and did not provide a critical assessment of Philippine science policy, it undoubtedly created greater awareness of the concept of science policy among NSDB and other officials. As shown earlier in this chapter, the national government subsequently adopted a Four-Year Development Plan for fiscal years 1974-77 which for the first time included statements on national science policy and NSDB's role in its education and manpower development plan.

In NSDB itself, there have been two studies made to assess national science policy with the aim of evolving a more relevant program of science development that would be integrated with national economic plans. The first of these studies was done by an Ad Hoc Committee on National Science Policy appointed by NSDB's Board of Governors in November 1973.[109] The Committee worked on a proposed science policy

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[108] Op. cit., see n. 68 of this chapter.

[109] The Committee was chaired by the Vice President for Academic Affairs of the University of the Philippines. Its members were representatives from NEDA, NSDB and DEC. The Committee held 10 meetings from January to October 1974. Information on the Committee's work was gathered from interviews with Mr. Hipolito Talavera, Acting Chief of Administrative Services, NSDB, Metro Manila, 31 May 1976 and 24 November 1976. Talavera acted as secretary of the Committee and provided most of the materials on which the deliberations were based. These were mainly documents of UNESCO-sponsored conferences on science and technology policy and its application in Asia, and OECD reports.

and a draft was ready in April 1974. This was circulated by NSDB Chairman Medina to heads of organic and attached agencies, the Department of Education and Culture and University of the Philippines for comments and suggestions. The comments centered on such issues as how much basic research should be supported; whether decision making on science policy should be made by NEDA or the Cabinet, whether the NSDB Chairman should also be a member of NEDA Board and others. Based on these comments, the Ad Hoc Committee prepared a final paper on the "National Science Policy of the Philippines".[110] It contained general normative statements for the guidance of government which were not backed up by empirical studies. Quite likely this was the reason why it was not adopted by the NSDB Board of Governors. Moreover, NSDB Chairman Medina's term was about to expire.

Meanwhile, increasing government concern with science policy and its relation to national development was becoming evident from the President's pronouncements and speeches.[111] In July 1974, he directed the NEDA Director General to look into the administrative problems of different science agencies and to recommend solutions in the shortest time possible. Within a year, the Balik-Scientist Program of the NSDB, Department of Tourism and Association of Colleges of Agriculture in the Philippines was launched.[112]

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[110] National Science Development Board, Board of Governors, Ad Hoc Committee on National Science Policy, "Proposed National Science Policy of the Philippines," (7 October 1974, mimeo.), 22 pp.

[111] See, for example, "President Orders Review of Policies on Science," Philippines Daily Express, 12 July 1974, pp. 1, 2.

[112] Details of this program will be discussed in Chapter IX.

In August 1975, NSDB and NEDA jointly sponsored a workshop on "Role of Science and Technology in National Development." The Workshop was attended by 170 government scientists, administrators, university officials and faculty, representatives of industry and professional organizations. It was the first effort to relate systematically the general aspect of planning for economic development with scientific research and development. The workshop was expected to generate recommendations on general areas of priority for research and development projects and programs in each sector; possibilities for making sectoral plans supportive of research efforts; and use of research results. Some of the recommendations made and discussed at the workshop were:

> 1. The NSDB should function as a repository of scientific research, whether of domestic or foreign origin. Therefore, expired patents of other countries can be compiled and made available to local industries by the NSDB.
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> x x x
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> 3. The Filipino researcher must acquire the expertise so that the practice of hiring foreigners as consultants would be minimized and domestic know-how would eventually be available.
>
> 4. The high rate of growth in industrial technology must not leave the education sector behind so as not to cause a gap which is detrimental to the development process. A response in the educational sector to the demand for manpower in the utilization of technology must be present.
>
> 5. Research ideas and their implementation seemed to originate mainly from the government sector and academic institutions. Perhaps a restructuring of the NSDB would be needed so that seemingly indirect participation by the private sector could be improved.[113]

In July 1976, the NSDB Board of Governors commissioned the Synergistic Consultants, Inc. (SCI) to undertake another study on

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[113] National Science Development Board, Report on the Recently Concluded NSDB-NEDA Workshop on the Role of Science and Technology in National Development (9 October 1975, mimeo.), p. 7. The workshop took place on 11 to 12 August 1975.

science policy.[114] The SCI group collected data on five broad areas of science policy, namely: (1) planning, coordination and assessment of scientific and technological research and development; (2) mission-oriented programs for research and development; (3) scientific and technological manpower development through science education and promotion of science consciousness; (4) technology transfer, diffusion and innovation; and (5) development of favorable climate for the advancement of science and technology.

The preliminary results of SCI's "Science Policy Studies" were presented in a two-day seminar-workshop in February 1977 which was called by NSDB for the purpose of getting some feedback from science administrators, the scientific community, private industry and educators. One of the workshop groups dealt specifically with policies proposed by SCI on scientific and technological manpower development. Among the recommendations of participants in this workshop group was that NSDB should assist in the establishment of a consortium among universities and colleges to provide graduate science and technology education in the country. Such a consortium would set up an Institute of Mathematics or Institute of Physics which would pool together the available faculty which is presently found in several institutions.[115] Another recommendation was the

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[114] National Science Development Board, Board of Governors, 13th S/M, 19 July 1976. The SCI study group was composed mainly of faculty members of the University of the Philippines with advanced training in the sciences such as physics,biology,zoology,and business administration.

[115] National Science Development Board, Seminar-Workshop on Science Policy, Proceedings and Summary Report (Metro Manila: 1977, mimeo.), pp. 54-55. The concept of a consortium of universities to set up these Institutes was also proposed in 1971 by a study made for the Senate Committee on Education. See Republic of the Philippines, Senate Committee on Education, Higher Education Research Council, Higher Education in the Philippines, 1970-71, Vol. I (Manila: 1972, mimeo.), pp. 282-283.

creation of a position for an Undersecretary of Education for Science in the Department of Education and Culture. A third recommendation was that NSDB should be represented in all professional examining boards in fields related to science and technology.

The recommendations made by the workshop group on scientific and technological manpower development reflect important issues about NSDB's role in regard to government policies on education and training of scientists and engineers. NSDB was given the responsibility of formulating a program for effective training and utilization of scientific and technological manpower by the Science Act of 1958. The problem is that NSDB does not possess sufficient authority or financial resources to implement such program. It can only stimulate the development of such manpower through its scholarship grants, training programs and research activities. It has no authority over curricula of universities and colleges, no influence over the licensing of engineers, physicians and scientists, and has limited financial resources at its disposal to be able to influence the directions of research and development activities of other government agencies. In the past, NSDB's scientific and technological manpower development programs were formulated independent of the Department of Education and Culture's programs. It is only recently, that is, since reorganization in 1973, that a more direct link between educational policy-making and science-policy making has been institutionalized in the NSDB Board of Governors. The question that remains is what level of education should NSDB concentrate its efforts to achieve the government's goal of insuring an adequate supply of highly trained scientific and technological manpower for the country.

Summary and Conclusion

This chapter has shown that, as in many other countries, science developed initially with little government support. Concern with scientific research and development increased with the Spanish government's attempts to accelerate Philippine economic development during the nineteenth century as shown by the organization of the Royal Economic Society of Friends of the Philippines. Research in medicine and pharmacy was stimulated by the need to combat infectious diseases and promote public health. Meteorological studies grew out of the exigencies of protecting lives and property from typhoons that often devastated the islands. Towards the end of the Spanish regime, a government science laboratory was established and the imperative of supporting scientific research had been recognized.

During the American regime, science policy evolved out of the increasing application of science and technology in the expanding government functions such as, for example, promotion of public health, public works and infrastructure development, agricultural production and exploitation of natural resources. Consequently, there was a need for trained scientists, engineers and physicians. As discussed in Chapter III, government scholarships and state-supported institutions to provide training for these professions were created. There was thus a close link between science and educational policies during the initial stage of American rule. The relations between the Bureau of Science, University of the Philippines and Bureau of Health demonstrated this close coordination between science and educational policies.

The growth in the number of physicians, engineers and scientists gave rise to professional organizations. As discussed in Chapter IV and in this chapter, some of these associations worked for the creation of the National Research Council of the Philippines and other science agencies such as the National Science Development Board and National Pollution Control Commission.

From 1935, as part of the transition to independence, Filipino scientists replaced American and other foreign scientists in the Bureau of Science and other agencies such as the Departments of Agriculture and Health. During this time, development of science and technology had to compete with other programs for government support. It became apparent after 1946 that science had been neglected during this period and had, moreover, suffered from the destruction brought about by the Japanese occupation during World War II. With increasing government preoccupation on the promotion of economic development, the need for national science policy assumed importance. This led to the reorganization of the Bureau of Science and the subsequent creation of NSDB and other agencies.

NSDB was created to take charge of formulating national scientific policies and programs and coordinating research and development activities of government agencies and private industry. Its effectiveness in carrying out these functions, has, however, been constrained by several factors. The mandate given to NSDB by the Science Act of 1958 was not initially supported by adequate financial resources and authority. The lack of financial support was remedied in 1968 by the enactment of the Special Science Fund Law. President Marcos' administration has, however, placed new demands on NSDB's role as the government's principal science agency. The emphasis on science and technology as instruments of national development and the building of a New Society has resulted in the adoption of additional programs such as regional science high schools, assistance to higher educational institutions and to scientific societies, which necessitate the search for additional sources of funding. Moreover, the enhanced role of science and technology has brought about new problems of coordination between NSDB and the expanding government machinery.

While NSDB had been empowered by the Science Act to formulate science policy, the making of authoritative policies have actually been done outside NSDB, that is, Congress before 1972 and at present, the President of the Philippines. The effectiveness of NSDB's policy recommendations has, therefore, been dependent on its access to and support from policy-makers. Under the old setup, the scientist-administrators had to get the support of several groups and power centers (economic pressure groups, Congress and the President) in order to secure needed legislation. They had to have political skills of bargaining in order to influence national decision-making. Obviously, they lacked these skills. With the more centralized, technocratic decision-making under Martial Law and NSDB's linkage with the NEDA, in the person of the Director-General who has shown a strong interest in the role of science and technology in national development planning, there is a greater likelihood that science policy proposals may become authoritative legislation.

The past science administrators inherited the traditional bureaucratic structure in organizing NSDB. As they pointed out in interviews made for this study, Civil Service rules on recruitment and seniority, position classification, compensation and auditing rules had militated against their building up highly competent staff. Undoubtedly, these rules constrained the past NSDB leadership in attracting innovative personnel who could implement approved policies, formulate and propose dynamic programs for the development of science and technology.

NSDB's authority structure was reorganized in 1973 ostensibly to reflect its expanded role in policy-making for science and technology. However, there are science agencies which have remained outside NSDB's coordination and control. There are also newly-created agencies which tend to have overlapping concern with NSDB such as, for example, the Energy Development Board. There is thus the problem of coordinating their policies and programs with those of NSDB.

The above observations can partly be explained by the formal education and training of past NSDB chairmen which is elaborated in the next chapter. They have been trained to be scientists and researchers and not as managers and administrators. While they have held some executive positions in their careers prior to their appointment as NSDB Chairman, they have not been able to transcend the limitation of their formal training for the broader responsibilities of policy-making and directing the course of science in the country. For example, while they had some vision of what science should be for the Philippines, they seem to have failed to secure adequate legislation to support it. As one scientist who had sat with the NSDB Board of Governors commented in one of my interviews:

> Salcedo had a vision of what science should be for the country but he had no programs. Medina had a vision and laudable programs, but he was not a good manager. He depended too much on natural scientists and not on social scientists.

How NSDB and other science administrators perceive what science policy should be in the Philippines, particularly in the education and training of scientists and engineers will be the subject of the next chapter.