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

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

by

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Chapter VII

Science Policy and the Education and Training of Scientists and Engineers: Perceptions of Government Officials

In this chapter, we shall look at the perceptions of NSDB and other administrators regarding the direction of policies for the development of science and the education of scientists and engineers in the Philippines.

A. Administrators of NSDB

Since the views of science administrators are necessarily shaped to some extent by their professional life experiences, a brief profile of NSDB chairmen is presented.

From the time NSDB was established (1958), four scientists have served as chairmen: Dr. Paulino Garcia (1958-1963), Dr. Juan Salcedo, Jr. (1963-1970), Gen. Florencio Medina (1970-1976), and Dr. Melecio Magno (1976 to present).[1] They represent different scientific fields: medicine (Garcia and Salcedo), chemistry (Medina) and physics (Magno). Salcedo is currently President of the Science Foundation of the Philippines while Medina is Chairman of the National Research Council of the Philippines. Both agencies are attached to NSDB for purposes of policy coordination.

Salcedo and Medina served in other administrative positions in the executive branch of government prior to their appointments as NSDB Chairman. Salcedo served as first Director of the Institute of Nutrition (1948-1950),[2] Secretary of Health (1950-1953) and Presidential Technical Assistant on Science (1962-1963). Concurrent with these positions,

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[1] The profile is based on biographical data furnished by the living administrators during interviews with the researcher. Dr. Garcia, a physician by training, died in 1963.

[2] The Institute of Nutrition evolved into the present Food and Nutrition Research Institute, an organic agency of NSDB.

Salcedo was a faculty member of the University of the Philippines (Institute of Hygiene and College of Medicine) and later Dean of its Graduate School. He was Chairman of the National Research Council of the Philippines (1961-1975). His scientific researches and publications are in the fields of nutrition and biochemistry.

Medina was faculty member of the University of the Philippines early in his career and served in the Armed Forces of the Philippines (1936-1958) where he subsequently became Director of the Research and Development Division. He was Science Adviser to the Senate Committee for Scientific Advancement, Congress of the Philippines (1957-1958). He was Commissioner of the Philippine Atomic Energy Commission during the period 1958 to 1964. From 1964 to 1968, he worked with the Department of Technical Assistance, International Atomic Energy Agency in Vienna, Austria, and became the Agency's Regional Officer for Asia and the Far East in Bangkok, Thailand (1968-1970).

Compared with his predecessors, Magno's work experience has been mainly in academia. He has held, in addition to teaching and research, various administrative positions in the University of the Philippines such as Department Chairman (Physics and later Meteorology), Chairman of the Division of Natural Sciences, Dean of the College of Arts and Sciences and Project Director of the UP-NSDB Graduate Manpower Program. He was Vice President for Academic Affairs of UP immediately prior to his appointment as NSDB Chairman.

These three (past and present) NSDB chairmen obtained their basic degrees at the University of the Philippines before World War II. Salcedo obtained the Doctor of Medicine degree, Medina finished both the Bachelor of Science and Master of Science in Chemistry,and Magno graduated with a Bachelor of Science in Mining Engineering. All of them later pursued

graduate studies or specialized training in the United States. Salcedo did his Master of Arts (in biochemistry) at Columbia University. Medina took specialized courses in radioisotope techniques from the Oak Ridge Institute of Nuclear Studies and in nuclear science and engineering at the International School of Nuclear Science and Engineering at the Argonne National Laboratory in Lemont, Illinois. Magno took both an M.S. and a Ph.D. in physics from Johns Hopkins University.

The three have also been active members of their respective scientific professional associations. Salcedo was once President of the Philippine Medical Association, President of the Philippine Association of Nutrition and founding President of the Philippine Association for the Advancement of Science (PhilAAS). Medina served twice as President and once as Vice President of the Chemical Society of the Philippines. Magno is active in the Philippine Association of Physicists and the PhilAAS. At the time of their appointment as NSDB Chairman all were over 55 years of age, and one was 65, that is, above the compulsory retirement age.

The incumbent Vice Chairman and Executive Director of NSDB, Pedro Afable is a graduate of the University of the Philippines, having finished his B.S. in Civil Engineering in 1933. He started his career in government service as civil engineer in the Bureau of Public Works and later became Technical Assistant at the National Economic Council (now the National Economic and Development Authority). He was Deputy Commissioner (1958-1964) and Acting Commissioner (1964-1971) of the Philippine Atomic Energy Commission (PAEC). During his stint at PAEC, he had several travel/observation tours of atomic energy research establishments (Japan, Australia, France, Spain and England), and research reactor projects and facilities (Taiwan and South Korea). He participated in international seminars/

conferences on nuclear power and other related subjects. He has been Vice Chairman and Executive Director of NSDB since 1971.[3]

The above profile shows that the four NSDB administrators interviewed have all been basically trained at the University of the Philippines, and except for Afable, had some advanced training at various institutions in the United States. They belong to the same generation, with Magno as the youngest in the group. They have occupied academic positions as well as administrative positions in government. Their career patterns are closely linked with the rise of government science agencies. Undoubtedly, their educational and career backgrounds have influenced their perceptions of what should be the direction of development of science in the Philippines and what should be the policies for the education and training of scientists and engineers.

Perceptions on Science Policy

One function entrusted to NSDB by the Science Act of 1958 was to plan the direction of government science. It provided that: "With the approval of the President of the Philippines," NSDB was to "formulate consistent and specific national scientific policies and prepare comprehensive scientific and technical programs which shall be observed and implemented by the government and all its subdivisions and instrumentalities."[4]

Testifying before the Senate Committee on Scientific Advancement of Congress in 1962, Salcedo who was then Acting NSDB Chairman, explained

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[3]Dr. Gregorio Zara, past NSDB Vice-Chairman and Executive Director, was not available for an interview.

[4]Republic Act No. 2067, 13 June 1958, Sec. 4, Paragraph (2).

that NSDB had not been able to implement the objectives of this provision of the Science Act. He stated:

> To date the NSDB has prepared 5-year National Research Programs for Industry, Agriculture, Foods and Nutrition. These programs were very carefully formulated after conducting a series of conferences, seminars, interviews with scientists, industrialists, researchers, resource persons, etc. In an official communication to the Office of the President of the Philippines, the NSDB sought the authority to secure implementation of these programs by research agencies of government and all its subdivisions and instrumentalities. Conversations were made with the Budget Commissioner with a view to regulate the approval of requests for appropriations for researches submitted to the Budget Commission. Slow progress towards this objective was made so that the NSDB has not been able to implement the objectives of this provision.[5]

Salcedo observed that the scientific activities of the Philippine government were developed "not as part of a master plan but rather as a response to the needs of specific program responsibilities of the various governmental departments and agencies." He explained that the "general policy was to allow science to develop in relation to specific missions of each governmental organization" such as health, agriculture, defense and others.[6] He pointed out that NSDB was actually organized to insure that government expenditures on research and development are undertaken in relation to national priorities. However, given only an average of 13.6 per cent of total government funds for research during his term as Chairman, "the NSDB programs could not have had the desired impact on the entire governmental system."[7] For this reason, Salcedo

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[5]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), p. 67.

[6]Juan Salcedo, Jr., "Industrial Research: An Imperative of Economic Progress," Science Review, Vol. X, No. 1 (January 1969), p.9.

[7]Ibid., p.10.

explained that NSDB had to be selective in its support for research projects, that is, it tried to fill the gaps in the research efforts of government. Priority projects which could not be undertaken by other government agencies because of lack of funds were given financial grants by NSDB. For example, as food production received a high priority in national development plans, a large share of NSDB funds went to agricultural research. Moreover, this was justifiable because the "agricultural agencies of the government had the research people and the capacity to undertake research."[8]

As a consequence of NSDB's funding priorities, the proportion of government funds spent on agricultural research increased from 45.4 per cent in 1959 to 50.2 per cent in 1966. Funds for industrial research decreased from 9.1 per cent in 1959 to 5.9 per cent in 1966.[9] As a whole, government spending for research shifted in emphasis from basic and fundamental research to applied research and development activities.

During his term as NSDB Chairman, Salcedo noted changes in policy-makers' attitude towards scientific research. As he put it, there was "a recognition of the shortsigtedness of traditional economic theories on economic growth which considered science and technology as more residual factors." He saw that decision-makers in both the legislative and executive branches of government had "explicitly recognized research as an important factor of production, which although it may not have immediate visible effects will eventually redound to our economic and social progress."[10] Consequently, more funds were allocated for scientific re-

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[8] Ibid.

[9] Ibid.

[10] Ibid.

search and development. This was done through the enactment of the Special Science Fund Law.[11]

In my interview with him, Salcedo recalled that the Special Science Fund increased the appropriations of NSDB and its agencies by "almost seven times" and "also increased indirectly the appropriations for research in other government agencies through NSDB grants-in-aid."[12] Salcedo said that during his term as Chairman, the President's support enabled NSDB to work for the establishment of additional science agencies. These were the Philippine Inventors Commission, Philippine Textile Research Institute and Forest Products Research and Industries Development Commission, which were placed under the supervision and control of NSDB, and Philippine Science High School and Metals Industry Research and Development Center which were attached to NSDB for purposes of policy coordination. These and other government agencies, discussed in Chapter VI, were effectively brought under the coordinative authority of NSDB because the Special Science Fund Law provided that the Budget Commission's releases of allocations from the fund had to be approved either by the Chairman of NSDB or the Chairman of the National Research Council of the Philippines.[13]

The creation of additional science agencies reflected Salcedo's desire to "institutionalize science in the Philippines and hence to get

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[11]Republic Act No. 5448, 25 September 1968, as amended by Republic Act No. 5470, 30 May 1969.

[12]Interview with Dr. Juan Salcedo, Jr., President of the Science Foundation of the Philippines, Metro Manila, 8 March 1977.

[13]Republic Act No. 5448, op. cit., Sec. 5.

more money for scientific research and development."[14] With the organization of these new agencies, he explained, NSDB was adopting a new approach -- "institution-building" -- in implementing its mandate of promoting scientific research and its application. Prior to this, NSDB had relied mainly on financial grants-in-aid to existing research institutions to stimulate research. Under the institution-building approach, NSDB first identified the problem area that was of top priority. The capacity of existing research institutions to deal with the problem was then assessed. Based on this assessment, NSDB would either strengthen an existing institution "or set up a new institution, provide it with the necessary financial and technical manpower inputs and monitor its effectiveness to deal with the problems it was set up to remedy."[15]

According to Salcedo, one of the basic goals of President Carlos Garcia in proposing to Congress the creation of NSDB in 1958 was the desire to shift from government to more private industry spending for research and development. NSDB attempted to implement this policy by providing more incentives to private industry through offers to finance research undertakings and by certifying equipment or donations for research that should be exempt from taxes. However, Salcedo explained that "research by private industry is expensive, and development is much more expensive -- especially when we consider the chronic low level of capital that is available to the private sector even for establishing industrial projects." He pointed out that the question that should really be raised is whether government should continue to provide more funds for research

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[14] Interview with Salcedo, 8 March 1977.

[15] Salcedo, "Industrial Research: An Imperative of Economic Progress," op. cit., p. 16.

"until private industry has built up its capacity to contribute substantially to research."[16]

Salcedo stressed the importance of industrial research in the development of the country. As he put it:

> To plan for national development, it is necessary to recognize the close interdependence of industrial development and agricultural development. Industrial research plays a major role in maintaining this interdependence and in progressively shifting the base of an economy from agriculture and handicrafts to manufacturing industries.[17]

Thus, aside from encouraging industrial research activities in the National Institute of Science and Technology and Philippine Atomic Energy Commission (which were both under NSDB's supervision during Salcedo's time), NSDB worked for the creation of the Philippine Textile Research Institute and other research agencies to aid directly in the country's industrial development.

At an Industrial Research Workshop held in Baguio City in January 1969, Salcedo made several recommendations on the roles of government and private industry.[18] First, he proposed that in the importation of industrial technology "preference could be given to the import of 'processes' rather than the import of 'turn-key plants'." Under the first arrangement, factories can be designed and built to adapt imported technological processes to local conditions. This would enable local design and engineering organizations to be set up and gain experience which in turn would make possible, in the course of time, "the scaling up of the results of indigenous research and their application to the country's developmental efforts." Under the turn-key arrangement, factories are designed and

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[16] Ibid., p. 9.

[17] Ibid., pp. 10-11.

[18] Ibid., p. 17.

built by foreign firms using imported technology and materials and local labor. Once completed, these are then turned over to the government or to local industrialists who will run these. This makes the new factories heavily dependent on the foreign firms for services and repairs and this includes foreign technologists and imported spare parts.

Second, Salcedo proposed that the government should "consider sponsoring, subsidizing and even (totally) financing any new technology of promise" and private industry should "participate directly in the development of a new product or process being undertaken in government laboratories." Third, he recommended that "communication between the Government and Private Industry should be made more effective, both at the policy-making and implementing levels." He proposed close collaboration in research between government and private industry. For example, professionals in private industry should be encouraged to spend time in government research centers and vice versa, that is, researchers in government should be encouraged to spend some time in industries whenever possible to give them experience on industrial problems and approaches.

A fourth proposal of Salcedo was a joint collaboration in "market surveys, evaluation of projects requiring research, operations research." He cited NSDB's participation in a comprehensive study of the textile industry as an example. Fifth, he proposed that research personnel from both government and private industry should be encouraged to join professional societies where they can exchange ideas and technical information. He suggested that a professional association specifically for industrial research personnel could be organized.

During Salcedo's term as NSDB Chairman, the Governing Board set up guidelines for the allocation of financial grants for research. It was

decided that 10 per cent of total research funds should go to basic research, 85 per cent to applied research and 5 per cent for the promotion of science consciousness and public understanding of science. Salcedo recalled that he was later questioned about these priorities in funding of research projects in the Congress. He said that he had to explain to the members of Congress that at this stage of our development, "the Philippines can not afford too much of basic research."[19]

When Florencio Medina took over as NSDB Chairman in 1970, the research institutions created during Salcedo's term were already in operation. The guidelines laid down by NSDB's Governing Board for funding research and development were followed during Medina's tenure. As a result of the declaration of Martial Law by President Ferdinand Marcos in September 1972, the role of NSDB in directing development of science in the country was greatly enhanced. There was a noticeable increase in the government's concern with national science policy as a component of national development planning. This was a consequence of the government's goal of building the "New Society".

Queried about his role in the formulation of the goals of the science development program in the Four-Year Development Plan[20] when he was NSDB Chairman, Medina said that he was not consulted in the drafting of the Plan. He thought that this was a mistake as he believed that there should be a forum where scientists, economists, and development experts can get together to influence science policy. He stressed: "Economists alone should

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[19] Interview with Salcedo, 8 March 1977.

[20] The Plan was referred to in Chapter VI, pp. 274-275.

not dictate what should be the development of science because we are also concerned with the effects of science on society and not just the growth of the economy."[21] Yet the policy statements on science development enunciated in the Plan reflect the views on science policy that had earlier been expressed by Medina in his speeches as NSDB Chairman. In one of these speeches, he said:

> In my view, science policy is the sum of the measures taken to increase and use a nation's scientific and technological potential. It involves planning for the development of scientific disciplines such as chemistry, physics, biology, mathematics, etc.; the development of scientific and engineering manpower as well as scientific and technological institutions; the direction of science and technology to meet the social and governmental needs; and the application of science and technology to economic development.[22]

Medina believed that scientific development and higher education must take into account their impact on national development. He considered the development of science in the Philippines to be aimed not just at science for science's sake, just as higher education is not pursued simply for education's sake. He stressed:

> I have always held the view that the basic task of science and technology is to help in every possible way in the development of a pattern of national economy for the Philippines wherein the basic essentials in living are produced locally and industrial raw materials are also locally processed instead of exported in raw form. This is a kind of economy that is naturally more prosperous and stable because it will, on the one hand, conserve currency earnings from foreign trade and at the same time, put to work millions of our unemployed in the numerous processing and finishing industries.[23]

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[21] Interview with Brig. Gen (Ret.) Florencio A. Medina, Chairman, National Research Council of the Philippines, Metro Manila, 1 April 1977.

[22] Florencio A. Medina, Science, Development, Higher Education, Perspectives (Manila: April 1975), pp. 131-132.

[23] Ibid., p. 146.

Medina recalled that during his term as NSDB Chairman, he always emphasized that the development of science in the Philippines should aim "towards getting improvement in the rural areas for the greatest good of the greatest number. The need was for health care, improving the low levels of livelihood, tackling the housing problem, and the like."[24] He cited as an example of the operationalization of this goal a research project that he started in General Trias, Cavite, to demonstrate the effective utilization of cheap housing materials and the use of biogas and windmills to generate power for household use in the rural areas. He also gave as an example his personal encouragement of research on the use of alcohol as motor fuel by scientists in the R & D Division of the Armed Forces of the Philippines and later on in NSDB. The success of the NSDB experiments was demonstrated on 22 December 1976 when an NSDB vehicle was tested using as fuel a mixture of (crude) commercial alcohol with gasoline.[25]

Medina pointed out that scientific research on the use of alcohol as motor fuel in the Philippines started long before World War II. He recalled that alcohol mixed with gasoline (locally called gastarla or gasanol) was being used to fuel passenger buses in Manila. While serving as Director of R & D Division of the Armed Forces of the Philippines, he continued to work on this problem. The results of these experiments were

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[24]Interview with Medina, 1 April 1977.

[25]A. G. Ayo, "Alkoline Anyone? An Energy Supplement," UP Newsletter, Vol. V, No. 3 (24 January 1977), pp. 1, 2. Similar experiments were also conducted at the Philippine Atomic Energy Commission and Philippine National Oil Commission (PNCO). The vehicles used by PNOC have run on a blend of 15 per cent alcohol and 85 per cent gasoline fuel.

presented at the Eighth Pacific Science Congress held in Manila in 1953.[26] Medina remembered that Dr. Gregorio Zara[27] constructed in 1954 an airplane fueled with alcohol which Zara himself flight-tested over Manila. Medina believed the problem is no longer the possibility of using alcohol as motor fuel but the economics of producing the needed alcohol in the country.

In arguing for more attention to the flow of technology to the rural areas, Medina stressed that NSDB's research program would not necessarily be limited to agriculture. Rather, it should be concerned with "the processing of goods in the farm. This means an expansion of projects of small scale industry. We should not only think of big industries where the rich can invest. This only widens the gap between the rich and the poor."[28]

With regard to relations between NSDB and private industry during his term as Chairman, Medina explained that he tried to establish closer liaison through the professional societies. He recalled:

> The late Chairman Garcia sent out teams to industry to tell them what NSDB could do for them, but they did not respond to these offers. Dr. Salcedo tried another approach. He sent

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[26]Interview with Medina, 1 April 1977. See also Florencio A. Medina and Research and Development Division Staff, Armed Forces of the Philippines, "Alcohol as Military Motor Fuel," in Pacific Science Association, Proceedings of the 8th Pacific Science Congress, Vol. VI-B (Quezon City: National Research Council of the Philippines, 1963), pp. 165-203.

[27]Dr. Zara subsequently became Vice Chairman and Executive Director of NSDB from 1958 to 1969.

[28]Interview with Medina, 1 April 1977.

> out letters to industry offering to them use of these facilities. I continued to encourage direct contact between NSDB personnel and industry. I told them (representatives of industry) that our staff could be invited to their industrial plants to help them work out solutions to their technical problems. This was not also taken advantage of by industry. The reason is because each particular industry has its own trade secret. If they worked out researches in public laboratories they are afraid there would be leakages of information.[29]

Medina said that during his term he tried to institutionalize the linkages between NSDB and the professional scientific and technological organizations. Relations between NSDB and these associations had been largely on an informal basis, that is, staff members of NSDB who are members of these associations or societies usually brought to the latter's attention the programs of NSDB. But this liaison with NSDB was insufficient and unsatisfactory, according to Medina. He had encouraged the establishment of a Center for Scientific and Technological Organizations (CSTO) within the NSDB Science Complex in Bicutan. As he put it:

> I called to the NSDB at one time officers of the Council of Organizations on Technology and Allied Sciences of the Philippines (COTASP). It was made up of 19 scientific and engineering organizations at that time. I informed them that many of the NSDB-funded researches in the field of applied industrial research done in various research institutions and universities have been finished but they don't find their way to the factories, production lines, etc. I told them that because they were members of COTASP and also workers in industry, there could be closer relations between NSDB and industry through their professional associations. I suggested that they could set up an office within NSDB where they could meet everyday. I gave them 1,000 square meters here on condition that they take care of the architectural plan for the building. They did show me a plan of the building. The problem is that they were caught by the Presidential ban on new building contructions in the government. But the idea is there and the attempts have been made to establish linkages with professional societies and through them, with industry.[30]

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[29] Ibid.

[30] Ibid. For details on the CSTO project, see Chapter VI, pp. 296-298.

In the relations between NSDB and universities, a new development during Medina's term was the institutionalization of the UP-NSDB Integrated Research Program in 1971. The University of the Philippines had been conducting researches for NSDB since the latter's establishment in 1958. However, before 1971, all proposed research at UP which was to be funded by NSDB had to be evaluated and approved on a project basis, first by the Office of Research Coordination at UP and then by NSDB's project evaluation panel. This proved to be a very slow and cumbersome procedure. Medina recalled that when he took over as Chairman of NSDB, he was invited to speak before the faculty of UP. He recounted that knowing the financial situation of the University at that time:

> I committed five million pesos to support research in Los Baños and Diliman with the understanding that there would be a revision of the methods of evaluating projects. I proposed that the Research Coordinators of the University should compose a team to which I could send our team to evaluate project proposals so that there would only be one evaluation at a time. The UP would decide how much of the research funds would go to Diliman and how much to Los Baños.[31]

Negotiations between officials of UP and NSDB resulted in the establishment of the UP-NSDB Integrated Research Program. Under the program, NSDB appropriations for research for the University of the Philippines was to be given in lump sum.[32] The UP would be responsible for the technical details of research projects such as the evaluation of qualifications and research capability of the proponents of projects.

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[31] Interview with Medina, 1 April 1977.

[32] Interview with Dr. Abelardo G. Samonte, Chancellor, University of the Philippines at Los Baños, 14 February 1977. Dr. Samonte was UP Vice President for Academic Affairs and negotiated with NSDB the details of the UP-NSDB Integrated Research Program.

NSDB's concern will be mainly to ensure that these projects are in accordance with the policies and priorities laid down by its Board of Governors.

During his term, Medina noted that NSDB's grant-in-aid for research and development went to no more than ten universities, one college and one medical institute, out of the then 37 private universities, 566 private colleges and seven state universities and colleges. The funds that went to UP at Diliman and UP at Los Baños were approximately 90 per cent of NSDB's total assistance to institutions of higher education in 1973.[33] Medina explained that this situation prevailed because of the absence of a national system of certifying the competence and research capabilities of universities and colleges. Thus, NSDB's "program of assistance has been confined to those institutions whose research capabilities have been ably demonstrated by their past research efforts."[34]

Medina explained that NSDB has tried to encourage increased involvement in research among private universities as they have a potential which has remained untapped. However, there were several difficulties in working out NSDB research projects with private universities. One of these is the different modes of payment of faculty members among private universities. Some universities pay their faculty regular salaries while some pay them by the number of credit hours taught each semester. This poses difficulties of determining research honoraria to be paid by NSDB to compensate for salary lost because of reduced teaching load. Medina also pointed out the problem of space among private universities. As he

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[33] Medina, Science, Development, Higher Education, Perspectives, op. cit., p. 57.

[34] Ibid.

put it: "Would they be willing to provide space for new research equipment or new laboratories? Moreover, there are pieces of equipment that require air-conditioning. Would the private universities be willing to put these up?"[35]

When asked about his own interpretation of the increasing interest by the Philippine government in science policy, Medina thought that "Science policy is not a problem. It is the implementation which is a problem." At the same time, he recognized that "Science policy is complex and its implementation involves many other government policies. Science policy should be flexible, relevant and utilitarian."[36] To explain what he meant, he cited the case of technology transfer. He emphasized that there is a need for government to be selective in deciding what foreign technology to adopt in the country. In his view: "We should not adopt all foreign technology but only those which are suited to local conditions." He noted that a lot of industrial establishments still import their raw materials.

To improve the implementation of science policy, Medina believed that there is need to restructure NSDB to give it more authority and to "rid itself of its ineffective staff members." He pointed out that any presidential decree issued for the purpose of strengthening NSDB should try to give its Chairman more authority and establish effective linkages between NSDB and other agencies such as the Energy Development Board and National Economic and Development Authority.

Under Dr. Melecio Magno's leadership, NSDB's goal of bringing science and technology to the rural areas to help uplift the living conditions of

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[35] Interview with Medina, 1 April 1977.

[36] Ibid.

the majority of the country's population has been given top priority. NSDB's program aims to apply the results of researches and discoveries over the years to assist rural people in improving quality of life and attaining economic progress. The program will, according to Magno, show that "improved (scientific and technological) know-how is not a monopoly of those who could afford but could also be availed of by farmers who are willing to accept change and improvement in their livelihood."[37] Results of studies on food processing, food production and plant propagation, new farming techniques, the use of methane gas as fuel, mushroom culture,and others, are being disseminated to the rural areas by NSDB's 12 regional offices.

Interest in national science policy has been revived under NSDB Chairman Magno. In July 1976, the Board of Governors commissioned Synergistic Consultants Inc. (SCI) to undertake studies on science policy.[38] Magno explained that the results of these studies would be the basis for recommending the necessary changes in NSDB Organization. As he put it:

> When I was appointed as NSDB Chairman, they asked me to reorganize NSDB in consultation with the Chairman of the Reorganization Commission. We thought that before reorganizing NSDB, we must look first at science policy. Once we have conducted the study on science policy, then restructuring the organization of activities in science and technology in the country will follow.[39]

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[37]"NSDB Bares Technology Program in Rural Areas," Bulletin Today, 27 December 1976, pp. 1, 17. See also "NSDB Head Cites Key to Rural Uplift," Bulletin Today, 14 March 1977, p. 31.

[38]13th S/M, National Science Development Board, Board of Governors, 19 July 1976. The studies were done by SCI from July to December 1976. SCI's team of researchers were young scientists with advanced degrees in physics, biology, zoology and business administration. The scientists were faculty members of the University of the Philippines. SCI itself is a private consulting organization.

[39]Interview with Dr. Melecio Magno, Chairman, National Science Development Board, Metro Manila, 23 March 1977.

Magno expected that the results of the study on science policy would serve as inputs for NEDA's planning. He said:

> The science policy as proposed by SCI is based on the NEDA plan and hopefully the NEDA plan will also reflect plans for science and technology. In other words, it is a sort of feedback. The influence would be reciprocal.[40]

On NSDB's present role in policy-making for the country, Chairman Magno explained that a proposed presidential decree on science and technology is referred to NSDB as a matter of course. For example, he said that NSDB was consulted on the establishment of the Technology Resource Center as well as the reorganization of the National Pollution Control Commission.[41] He added:

> As far as I know, most if not all of the presidential decrees affecting science and technology were, if not referred to us, made known to us. Our comments have not always been solicited. They do not have to get our comments for us to submit. If it is a matter of interest to the science and technology community, I think, whether we are asked to comment or not, we have to.[42]

As NSDB Chairman, Magno explained that he is expected to attend regular Cabinet meetings as he has the rank of a Cabinet member although NSDB is not a regular department. He is ex-officio member of the Batasang Bayan, the interim national legislative assembly. However, the NSDB Chairman is not presently a member of the NEDA Board. The reason for this, Magno pointed out, is that:

> According to Secretary Sicat, many matters discussed by the NEDA Board are not directly concerned with science and

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[40] Ibid.

[41] The National Pollution Control Commission was reorganized and transferred from NSDB to the Office of the President under Presidential Decree No. 984, 18 August 1976; the Technology Resource Center was created by Presidential Decree No. 1097, 23 February 1977.

[42] Interview with Magno, 23 March 1977.

> technology research. Obviously, the implementation of the economic programs of the country would involve science and technology, but this would be more concerned with the application, the implementation of policies - something which the NSDB is not expected to do. The NSDB is concerned mainly with research and development and not with implementation.[43]

Magno stated that the NSDB Chairman sits with the NEDA Committee that is drafting the development plan, in the area where science and technology will be involved in long-term and immediate-term planning.

Research priorities in NSDB are set by its Board of Governors. These have been closely linked with the national plans of NEDA as NEDA's Director General is now a member of NSDB's Board of Governors. Magno observed that since he became Chairman of NSDB, Secretary Sicat has been active in the NSDB Board of Governors' meetings. In fact, some current innovations in NSDB policy were recommended by Sicat. One of these is NSDB's financial assistance to scientific and technological associations/societies not only in matters of publication but also in other activities such as the conduct of seminars, workshops, and attendance in conferences abroad. Previously, NSDB assistance to scientific organizations was confined to financing their publications. A second change in NSDB policy is the increasing assistance to educational institutions not only in terms of scholarship grants but also in terms of

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[43] Ibid. These views were in fact expressed by Gerardo P. Sicat, Secretary of Economic Planning and Director General of NEDA, in an extemporaneous speech delivered before the NSDB-sponsored Seminar Workshop on Science Policy on 15 February 1977. Sicat said:

> About 90 percent of the discussions we have in the NEDA Board refer to many policies that do not have direct linkage with science as such. And we would probably discover that if he were to sit in the NEDA Board, the Chairman of the NSDB would become, by the end of his tenure, the greatest doodler of us all, if doodling is an art that people do to keep themselves active in an inactive setting.

See National Science Development Board, Seminar-Workshop on Science Policy, Proceedings and Summary Report (Metro Manila: 1977, mimeo.), p. 90.

upgrading faculty, laboratory and library facilities. Priorities in this proposed assistance will be given to state colleges and universities; private institutions of learning which are potential contributors to NSDB's research effort will also be assisted.[44]

The priorities in NSDB's Manpower Program, according to Magno, are presently determined in consonance with NEDA priorities as well as those of the National Manpower and Youth Council (NMYC). The latter is an interdepartmental agency which is headed by the Secretary of Labor. The NSDB Chairman is member of the NMYC. NSDB is presently updating its studies on existing scientific and technological manpower in the country.

In regard to relations between NSDB and private industry, Magno pointed out that NSDB has recommended to the President the appointment of the two members of the Governing Board representing the private sector. However, the President has not seen fit to appoint anyone to fill in these positions. Magno observed that NSDB has taken steps to include the private sector in its policy-formulation process. For example, there were representatives from the private sector in the NSDB-sponsored Seminar-Workshop on Science Policy in 1977. NSDB also has inter-agency committees in which the private sector is represented. Magno gave as examples the Committee on Environmental Science, Committee on Health Sciences and Committee on Electronics and Telecommunications which are making studies on what projects can be supported by NSDB. Moreover, NSDB encourages professional associations, which are usually made up of representatives of the private sector, to propose projects for NSDB funding. For instance,the Packaging Institute of the Philippines, which

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[44]Interview with Magno, 16 March 1977.

has over 100 members, has proposed the setting up of a Packaging Research and Development Center within the Forest Products Research and Industries Development Commission (FORPRIDECOM). FORPRIDECOM is a research agency of NSDB.

According to Magno, the President of the Philippines himself has been concerned with the fact that industry has not been doing as much research and development as it should. But Magno explained that this situation is due to the country's state of economic development and dependence on foreign technology. As he put it:

> Not many industries have the capability to undertake research as research is expensive. The subsidiaries of multinationals would rather depend on researches of the mother company. This is also true in developed countries. Even in Canada which is close to the United States, the subsidiaries of U.S. corporations still rely on the parent company's laboratories for researches.
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> Here, I think, not very many industries are doing research on their own, especially basic research. Most research done here is really market research. Even research in the adaptation of technology is not being done in the Philippines. This is a very much discussed subject and one reason for the creation of the Technology Resource Center. It is meant to be a resource for technology, an information center though not exclusively for technology. It was established to assist in the planning for human settlements, and also urban planning.[45]

The concern with the need for government to adopt a policy towards technology and science transfer and utilization was referred to by Chairman Magno in the NSDB-sponsored Seminar-Workshop on Science Policy held in February 1977. In a speech to the Seminar-Workshop, Magno expressed support for moves to "limit the amount of royalties paid for the use of foreign inventions to five per cent of their gross sales in

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[45] Ibid. TRC is referred to in Chapter VI, pp. 270-271.

the Philippines."[46] He emphasized that there is a need to regulate transfer of technology through multinational corporations. He believed that the regulation of royalties for foreign patents will encourage the utilization of local inventions.

Perceptions About Education and Training of Scientists and Engineers

Increasing government concern with science and technology policy has been accompanied by the examination of the country's educational policies particularly those affecting its scientific and technological manpower. This has been partly stimulated by the increasing emigration or "brain drain" of highly qualified scientific and technological manpower which are needed by government agencies and industry. One of NSDB's mandates is to ensure the development of an adequate supply of scientists and engineers for national needs.

Both former NSDB Chairmen Salcedo and Medina agreed that the training of physicians in the Philippines is not suited for the needs of the country. Both agreed that it is more suited for hospital, urban-based practice rather than for health care in rural areas. Salcedo, who as previously mentioned, is a physician by training and a former Secretary of Health, remarked:

> From first hand information, we are overtrained as MDs in the Philippines but undertrained as physicists, biochemists, etc. One way of looking at the problem of brain drain of physicians is that we are not giving our graduates sufficient training. If we train them for our needs alone, our graduates complain that we do not train them at all. Hence, they go abroad to get more training. Another way of looking at the problem of brain drain is that we are not paying enough to our scientists. Hence, they go abroad.[47]

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[46] "Urge to Limit Foreign Royalties," Bulletin Today, 15 February 1977, p. 24.

[47] Interview with Salcedo, 8 March 1977.

Commenting on the brain drain problem, Medina observed:

> Our medical training is for cities with hospitals. We now have enough doctors to man our hospitals. Our medical graduates go abroad because their training requires laboratory facilities that we do not have in the rural areas. There is, therefore, a general feeling that for our medical needs, another course in needed. In 1965, the U.P. College of Medicine under the leadership of Dr. Paulo Campos put up a project with NSDB support in Bay, Laguna -- the Comprehensive Community Health Program -- which gives UP medical students the opportunity to learn about rural medical health needs. This was intended to be a demonstration project for the other medical schools to see. This program should be adopted by the Department of Health on a national basis as it has already been demonstrated to be a more effective program of health care delivery in the Philippines.[48]

Both Salcedo and Medina recognized the importance of the current UP experiment in Leyte on a revised curriculum for training medical manpower suited to Philippine needs.

The NSDB administrators are agreed that there is need for highly trained scientists and engineers in the Philippines in various disciplines especially for research purposes. Speaking from his own teaching and research experience, Salcedo observed that holders of the M.D. degree with a Ph.D. degree are better trained as researchers than those who have only an M.D. or a Ph.D. degree. He recognized the need for advanced training in various scientific fields. As he admitted:

> When I was a young scientist, I always thought that nutrition can stand alone. I encouraged the study and research in nutrition in the Philippines. Later on, I learned that nutrition has to be supported by other sciences. We should also involve the social sciences because they serve as the bridge between the humanities and natural sciences.[49]

Medina thought that the existing curriculum for training in his

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[48]Interview with Medina, 8 March 1977.

[49]Interview with Salcedo, 8 March 1977.

field, chemistry, as well as for chemical engineers, is suitable for employment purposes in business or industry. However, it is inadequate for those who would like to put up their own small-scale industry. The curriculum fails to teach the chemist management skills and knowledge about requirements of government for putting up business or small-scale industry. As far as training for research in chemistry is concerned, Medina believed that research should be done by one who has at least an M.S., better still, a Ph.D. degree. These individuals can do independent research. He is in favor of apprenticeship training for research and the concept of team research. As he put it:

> Scientific research is not strictly scientific. It is an art and the research techniques are not all in the books. Those not in the books have to be transmitted from the master to his assistants. The professorial chair in research should be occupied by a scientist with young graduates apprenticed to him whom he can train for independent research.[50]

With respect to the problem of availability of adequate scientific manpower and facilities in the Philippines to support local graduate programs of study, Medina believed that there exists a sufficient pool of trained Filipino chemists and chemical engineers who can offer graduate programs both in the M.S. and Ph.D. degrees. However, these are not found in a single university but are dispersed in various institutions in the country. This is also true in the field of physics. He recalled that even when he was not yet in NSDB, he had already been suggesting the establishment of a consortium among several schools and a system of accreditation in order that the M.S. and Ph.D. programs in physics could be set up within the country. In 1975, a committee was

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[50]Interview with Medina, 8 March 1977.

organized composed of heads of the physics departments of the University of the Philippines, Ateneo de Manila University and De La Salle University to work out details for implementing such a program.[51]

Medina recognized that graduate programs in science and engineering are very expensive. Hence, he encouraged the idea of a consortium of schools offering graduate programs to ensure quality instruction. He realized that there was an urgent need to develop programs for advanced training of scientists within the Philippines as

> Graduate education in foreign countries is to be expected, oriented toward conditions, problems and realities in those countries ... Many of our young Filipino graduate students who go to foreign countries for graduate studies consequently become more attuned to conditions and realities far removed from the realities of Philippine society. Moreover, they tend to develop unrealistic expectations, both economically and professionally, upon their return to the Philippines. As a result, graduate education obtained abroad, in some cases leads to frustration, alienation and disorientation on the part of a returning Filipino.[52]

He recalled, for example, that as Commissioner of the Philippine Atomic Energy Commission (PAEC), he worked for the revision of training grants in the field of nuclear science from a program of one-half to one year training to a program producing nuclear scientists with Ph.D. As a result of this latter program, there are now more than a dozen Ph.D.s in PAEC. However, three or four of those sent abroad to obtain their Ph.D.s did not return to the Philippines. Medina considered this not just a problem of brain drain but also the consequent delayed implementation of

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[51] Interview with Medina, 1 April 1977.

[52] Florencio A. Medina, "Overseas Training and the New Society," Science Review, Vol. XV, No. 4 (July-August 1974), p. 7.

programs (by at least eight years) as the individuals who did not return were sent with the main purpose of acquiring further expertise needed for anticipated projects of the agency. Thus, new grantees have to be sent abroad for training and, in the meantime, projects have to be postponed.

In the field of manpower policy, Medina said that in an NSDB meeting in 1970, it was decided that there was need to develop high level manpower in nuclear engineering in anticipation of the country's requirements. He proposed that the National Power Corporation (NPC) should hire new engineering graduates and send them to a graduate course at the University of the Philippines. As envisioned, ten of these new engineers and ten more from NPC ranks would be selected for graduate training at UP with NSDB funding. But he claimed:

> They didn't do it, so now, they are just pirating their needed manpower from PAEC. There is still a lot of need for highly-trained manpower. For example, there are only two petroleum geologists in the Philippines at present. Most of the people in the field are foreigners. For all we know, they may already have discovered oil in our shores but they are not telling us.[53]

In terms of policies for graduate education in science, Medina argued that graduate education must give greater emphasis on scientific investigations that have both potential and direct relevance to Philippine problems. He recommended closer relations between graduate schools and research institutions by requiring graduate students to work with research scientists in government and private laboratories. Scientists at NIST and PAEC were actually involved in advising graduate students of the University of the Philippines. Moreover, Medina emphasized that:

> In order ... to ensure quality and balance in our graduate program and in research activities, there is need to

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[53]Interview with Medina, 8 March 1977.

> regulate and monitor the establishment of graduate schools in our institutions of higher education.[54]

During both Salcedo's and Medina's terms as NSDB Chairmen, the grant of scholarships in science and technology was an important component of NSDB program for developing science. In formulating the policy governing the "Science Talent Search Program" in NSDB, Salcedo recalled that he received suggestions from professional scientific organizations such as the Philippine Association for the Advancement of Science (PhilAAS), Philippine Association of Physicists, Chemical Society of the Philippines and Philippine Association of Colleges and Universities. There was also frequent consultation with the Department of Education and Culture. The NSDB always tried to involve the DEC in its activities.

As NSDB Chairman, Medina witnessed the strengthening of institutional linkages between the NSDB and DEC. He became member of the National Board of Education. He recalled that at one meeting, the DEC Secretary proposed that enrollment in such fields as law, education and medical technology should be limited.

> I questioned what was his basis for saying so. Has anyone ever done projections of what would be our manpower needs in 10 years, 20 years, etc.? I pointed out that we could not say that we have an oversupply of manpower if we don't have these studies. It is very unscientific to limit enrollment without any basis.[55]

At the time that Medina was NSDB Chairman, Magno was project director of the UP-NSDB graduate manpower program. Magno recalled that there were

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[54] Medina, "Overseas Training and the New Society," op. cit., p. 8.

[55] Interview with Medina, 8 March 1977.

two or three Ph.D. scholars supported by NSDB who failed to return to the Philippines. There were also scholars who returned to occupy responsible positions. One became the head of the National Computer Center and another became director of the Marine Sciences Research Center of the University of the Philippines. Magno thinks the reason why highly-trained scientists do not return to the Philippines is that they are not familiar enough with current conditions in the country. As he put it:

> They possibly fear that they cannot continue the researches they are doing now because of lack of facilities. Some periodicals would be hard to get here and may be late by two to six months. There are very few knowledgeable people with whom they could talk to. That is also important in science. Unless there is a community of people of the same interests with whom one can talk to about his research projects, it could be very hard to do scientific work. That is why there are many Filipino physicists, who are Ph.D. holders, in the United States. They don't want to come back. They think that conditions here are worse than in many other places. That is why we have this Balik-Scientist Program to enable these people to come here and find out things for themselves.[56]

Magno believed that there is a need for high-level manpower in physics in the Philippines mainly for teaching. He commented:

> There are very few physics departments in the country and most of the teaching in physics is presently being done by non-physicists. We believe now that physics teaching for engineers should be done by specialists in physics. Considering that there are many engineering schools in the country, just filling up the positions of professors in physics in these engineering schools would require perhaps five if not ten times the number of Ph.D.s available here in the Philippines. Chemistry is another course that requires physics. A school offering a B.S. in chemistry or chemical engineering should have a strong physics faculty. We are not yet a sufficiently industrialized country and I can understand why physicists would not be needed too much for industrial research. There are also very few agencies in the government which require the services of Ph.D.s in physics at the moment.[57]

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[56] Interview with Magno, 23 March 1977.

[57] Ibid.

Magno observed that although NSDB put a high priority on physics as one of the fields for its undergraduate and graduate scholarship program, there were not many students who were motivated to go into physics. The reason for this is the limited number of jobs for physics graduates and the low salaries for these. At the U.P., although there was a master's degree program in physics, it was inadequate. There were few members of the faculty who could advise students on their theses and few periodicals available. This was the reason why many of the junior staff in the Physics Department went to the United States for their M.S. and Ph.D. degrees.

At present, Magno thinks that there are enough people in the field of theoretical physics in the Philippines who could put up a graduate program given sufficient motivation and opportunity. They are presently affiliated with different schools -- the U.P,, Ateneo de Manila University and De La Salle University. He admitted that he has shared this dream of former Chariman Medina of setting up a Ph.D. program in physics under a consortium arrangement. He was confident that these could be achieved with the present thrust of NSDB policy. He revealed that he had asked the people concerned to prepare a project proposal to NSDB along this line. As he put it:

> One of the possible changes in the policy of NSDB, as I can see it, is that it would be more involved in developing, increasing and maintaining the capability for science and technology of various colleges, schools and research institutions. The Board will assist in the development of institutions in science and technology aside from supporting researches and manpower training. The NEDA Director General himself is interested in this. He suggested that the Board strengthen proposals for developing the so-called "breeder sciences" such as physics, mathematics, etc. We shall, of course, require a large amount of funds. Right now, we have no money for this project. We need to convince the Budget Commission for this purpose. We must have the necessary information.[58]

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[58] Ibid.

NSDB Vice-Chairman and Executive Director, Pedro Afable, who is a civil engineer by training, believed that there is an ample supply of engineers with B.S. degrees in the Philippines but not of engineers with advanced training. He observed, that as far as the general curriculum for B.S. in engineering in Philippine schools is concerned, it is quite comparable to those in foreign schools. However, he commented:

> Our educators should be more cognizant of developments that are occurring in many developing countries in matters of attuning the curricular training of engineering graduates to the needs of industry. This is because it is in the industrial sector where our engineering graduates do not fit immediately. They should be given more practicum courses. Many of our engineering societies are mostly concerned with the general practice of engineering. But the needs of industry are different from practice engineering. Industry wants to make a project analysis, economic study or to plan the feasibility of a certain technique. Our engineering consultants are concerned mainly with buildings and structures. This is insufficient for the needs of industry.[59]

Afable believed that the various engineering boards of examiners are still thinking in terms of general engineering practice. On the other hand, NSDB is concerned with the problem of how to support the needs of development. He agreed with findings of some studies which showed that in developing countries, science and technology is more a part of the academic and cultural education rather than geared to meet the needs of industrial and economic development.

Perceptions on Problems of Science Policy Implementation

The NSDB administrators pointed to four related problems affecting the implementation of science policy in the Philippines. These are inadequate funding of scientific activities; the problem of coordination among government agencies who are producers as well as end-users of scien-

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[59]Interview with Mr. Pedro Afable, Vice-Chairman and Executive Director, NSDB, Metro Manila, 30 March 1977.

tific research, civil service rules governing recruitment and salaries of scientists, and auditing rules. These issues are related to the expansion of government programs in science and education.

During the first decade of NSDB's existence, government scientific activities were hampered by lack of funding. This was evident in testimonies presented by government scientists in the hearings conducted by the Senate Committee on Scientific Advancement in 1962.[60] The creation of the Special Science Fund in 1968 greatly increased financial assistance to scientific research and development. During the past three years, however, the problem of funding scientific activities has once again cropped up. This has been partly brought about by increasing demands on government science to meet the pressing needs of national development. Moreover, since 1972, the proceeds of the Special Science Fund which were to be used by NSDB for its science programs were cut by ₱10 million. This amount has been annually allocated to the Department of Education and Culture to finance approved educational development projects.[61] These projects are generally for the improvement of secondary schools, technical institutes, skills training centers, curriculum and staff development, expansion

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[60] Republic of the Philippines, Congress, Senate, Committee on Scientific Advancement, op. cit., passim.

[61] Presidential Decree No. 6-A, 29 September 1972, Secs. 10 (c) and 13, as amended by P.D. No. 365, 3 January 1974. P.D. No. 6-A originally provided for ₱15 million of the Special Science Fund to be transferred to the Education Special Account in 1972. This share of the Education Special Account was to increase to 50 per cent of total collections accruing to the Special Science Fund from 1 July 1972 to 30 June 1982. P.D. No. 365 reduced the portion of the Special Science Fund going to the Education Special Account to ₱10 million annually from 1 July 1973 to 30 June 1982. The rest of the revenues accruing to the Special Science Fund would continue to be administered by NSDB.

of agricultural secondary and higher education programs, and assistance, incentives toward planned development and improvement of programs and facilities in public and private universities.

Commenting on this development, Medina, who was then NSDB Chairman recommended that additional sources of funds for science and technology should be tapped in order to meet NSDB's expanding program of research activities.[62]

The need for additional funding for NSDB was confirmed by the present Chairman, Dr. Magno. He stated:

> We might run out of funds this year because of new programs,e.g. the regional science high schols, increased assistance to scientific and professional associations and the need to improve government capability for research. The funds may not be enough. This may be the first time that we will be short of funds. In the past, NSDB used to return some funds at the end of the fiscal year.[63]

A second problem in the implementation of science policy mentioned by the administrators was the coordination between NSDB and the rest of government departments, among science agencies themselves,and between these and private industry. Both Medina and Magno stressed the need for the President of the Philippines to fill up the present vacancies in the NSDB Board of Governors which are reserved for representatives of the private sector. This would provide better linkages between the government's science program and activities with those of the private sector. Moreover, both agreed that there is a need for closer coordination of

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[62]Medina, Science, Development, Higher Education,Perspectives, op. cit., p. 195.

[63]Interview with Magno, 16 March 1977.

policies and programs of NSDB with those of the Energy Development Board, Department of Education and Culture, Department of Health, and others. As Magno commented:

> There is still the problem of linkages with other government agencies, the heads of departments and other offices that have something to do with science or science education. For example, the Departments of Agriculture, Natural Resources, Industry, Education and Culture, and Health. During the past few months, I have been trying my best to strengthen these linkages through personal contacts. I don't think I have been able to do much during the past ten or eleven months except to establish linkages between NSDB and other agencies of government that have something to do with science. There is also the problem of coordination of the agencies of NSDB, both attached and organic agencies. There is some overlapping, for example, between PCARR and NSDB; NIST and PCARR. There is need to further rationalize the organization.[64]

He pointed out that results of science policy studies and management review of NSDB conducted by Synergistic Consultants, Inc. will form the basis of the contemplated restructuring of NSDB and its agencies.

A third problem mentioned by the NSDB administrators regarding science policy implementation concerned Civil Service rules on the recruitment, tenure and promotion of scientists and their position and salary levels which are fixed by the Office of Compensation and Position Classification (OCPC). Under the Civil Service principle of merit and fitness, the passing of appropriate government examinations is required for recruitment and permanent appointment in the competitive civil service. As applied to recruitment of scientists, this requirement has hampered the staffing of NSDB with highly qualified scientists. This is because certain scientific fields, like botany, physics, biology, volcanology and others, are not covered by civil service or board

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[64] Interview with Magno, 23 March 1977.

examinations.[65]

Salcedo recalled that during his term as NSDB Chairman, he was able to convince the President to declare scientists' positions in NSDB as belonging to the category of highly technical positions.[66] This move exempted scientists from taking civil service examinations as a prerequisite for permanent appointment. He admitted that, while this had certain advantages for NSDB, it also made it vulnerable to political interference in appointments. Despite their exemption from civil service examinations, scientists still had to contend with the traditional emphasis on seniority in promotions and in filling up vacancies in higher ranks. Strict adherence to this rule hindered the lateral entry of young but highly-trained scientists into NSDB.

The rules governing compensation and position classification were laid down by the Wage and Position Classification Office (WAPCO, now OCPC) based on the principle of equal pay for equal work done. Initially, positions within NSDB and its agencies were given higher salaries than comparable positions in government, for example, in the University of the Philippines. As Vice-Chairman Afable recalled:

> Scientists at the Philippine Atomic Energy Commission used to have higher salaries than the UP faculty. Hence, some UP scientists transferred to PAEC. When UP's salary scales were raised, there was an exodus back to UP.[67]

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[65] The enactment of Presidential Decree No. 997, 16 September 1976, attempts to remedy this problem. The decree confers civil service eligibility "on scientific and technological specialists in recognition of their dedication and contribution to the development program of the country." NSDB is assisting the Civil Service Commission in the implementation of this decree. See "To Grant Eligibility to Filipino Scientists," Bulletin Today, 1 January 1977, p. 17.

[66] Interview with Salcedo, 8 March 1977.

[67] Interview with Afable, 30 March 1977.

Over the years, salary scales at NSDB have not kept up with increases in other government offices. Consequently, NSDB and its agencies have lost some of their best researchers to UP or to private industry. Some of the positions vacated by these staff have been difficult to fill up. Commissioner Jose R. Velasco of the National Institute of Science and Technology (NIST), recalled that the position of NIST Commissioner had a much higher salary than Bureau directors in 1958. This is no longer true. As he put it:

> If I retire now, they would have a difficult time recruiting somebody to take my place because my present salary is only equivalent to that of an Associate Professor in UP.[68]

The effect of these government rules has been to constrain effective operations of NSDB and its agencies. An added problem has been budgetary restrictions on NSDB's staff development program. Medina recalled that NSDB had a fellowship program, of 10 slots a year since 1958, which would have sent qualified staff members for advanced training abroad. This was, however, discontinued because of government's restrictions on the country's foreign exchange reserves.[69]

As a consequence of these policies, Magno considered staff development as one of the major present problems of NSDB. As he put it, "the staff of NSDB is probably not as well trained for skills that are necessary for its purposes."[70] He feels that if graduate training is the main

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[68]Interview with Dr. Jose R. Velasco, Commissioner, National Institute of Science and Technology, Manila, 10 March 1977.

[69]Interview with Medina, 8 March 1977.

[70]Interview with Magno, 23 March 1977.

basis for evaluating the professional preparation of NSDB staff, it would certainly suffer in comparison with UP. According to Magno, the salary scales of research staff of NSDB and its agencies are still below that of UP levels. PCARR has been able to adopt UP salary scales for its staff but NSDB's moves along this line have been hampered by the lack of funds.

During his term as NSDB Chairman, Medina recommended that:

> In order to give flexibility to the organizational structures of NSDB and its agencies, NSDB should be authorized to formulate position classification for scientific and technological personnel as well as set qualification guides and salary ranges for each position... NSDB should be authorized to set rules and procedures for scientific and technological personnel management outside of WAPCO and Civil Service.[71]

This recommendation has yet to be adopted as government policy.

A fourth problem cited by the NSDB administrators as hindering the implementation of science policy concerned government auditing rules. The requirements for canvassing and public bidding for equipment and supplies are felt to be unsuitable for the needs of scientific research. These often delay implementation of research projects. Along this line, NSDB and PCARR appointed a task force to prepare an auditing manual for science agencies. At the time of my interview with Medina, a copy of the manual had already been sent to the Commission on Audit for government consideration and approval.[72]

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[71] Medina, Science, Development, Higher Education, Perspectives, op. cit., p. 194. The WAPCO (Wage and Position Classification Office) of the Budget Commission is now known as the Office of Compensation and Position Classification (OCPC).

[72] Interview with Medina, 8 March 1977.

B. Other Science Administrators

The Commissioner of the National Institute of Science and Technology (NIST), the Science Research Chief of the Biological Research Center of NIST and the Director General of the Philippine Council for Agriculture and Resources Research (PCARR) were also interviewed. The NIST is an organic agency of NSDB. It is in fact the oldest existing science research agency of the country, originating as the Bureau of Science during the American regime. PCARR is an attached agency of NSDB which was set up in 1973.

Both the NIST Commissioner and PCARR Director General got their basic degrees in agricultural sciences at the University of the Philippines and obtained their Ph.D.s from universities in the United States. The Chief of NIST's Biological Research Center obtained his M.D. from the University of the Philippines and his Ph.D. in Biochemistry from a United States university.

Perceptions on Science Policy

Before the government reorganization in 1973, NIST Commissioner Velasco was a member of NSDB's Governing Board. At present, he is not. In contrast to PCARR, the NSDB Chairman does not sit in on NIST'S internal policy meetings. However, the NIST Commissioner feels obliged to keep the NSDB Chairman regularly informed about developments as well as problems within NIST.[73] NIST's policy-making body is composed of the Commissioner and the heads of the Biological Research Center and Industrial Research Center. Within the framework of priorities set by the NSDB Board of Governors, and those of NIST, these Research Centers formulate their own research priorities.

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[73] Interview with Velasco, 10 March 1977.

Velasco commented that he is aware of the need for government science agencies to take the "pulse of industry" in setting up priorities in NIST's Research and Development Program. For example, NIST invited various government officials and representatives of the ceramics industry to discuss its plans to put up a Ceramic Research Center. The Commissioner, however, pointed out certain difficulties that he had observed in these meetings between industry and NIST. As he put it:

> There is something lacking in the thinking of industry. When they are asked to participate in these meetings, the thing that is uppermost in their minds is how to get material benefits, e.g. how to swing a loan application. I think this should not be raised in a meeting like this but in a meeting of enterprises. They should be thinking of what to emphasize in research, what they would get out of new technology.[74]

The public as well as industrialists, according to Velasco, tend to look outside the Philippines for advanced technology. He observed that the industrialists' first concern is how to raise capital and then how to import the needed technology or equipment. He felt that this attitude needs to be changed but it is somehow abetted by the government's policy or lack of policy on importation. He pointed out:

> If I am an industrialist, the banks will not lend me capital on locally invented equipment but on imported technology. But banks have no technologists on their staff to evaluate technology. Their basis for lending is on the purchase value of equipment. The government is a little weak in this regard.[75]

In a paper reviewing the progress of science in the Philippines for the past 25 years, the NIST Commissioner pointed to the unintended effects of government economic policies on the growth of science in the

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[74] Ibid.

[75] Ibid.

country.[76] He cited the policy of import controls adopted in 1949 which aimed to encourage industrialization and stem the outflow of foreign exchange. While the goals of the policy were laudable, according to Velasco, there were three main shortcomings in the implementation of this policy which adversely affected the development of science. As he put it:

> First, we missed to orient the trend of industrialization...
>
> In the absence of a definite policy on what industries to encourage, factories were built, not on the basis of needs or other sound consideration, but simply because a lucky person or group happened to get its hand on some foreign exchange.[77]

He cited the building of large factories for economy of scale without regard to the limited supply of raw materials.

Velasco pointed out that government's fiscal policy inadvertently encouraged the perpetuation of an import economy. He explained that:

> to encourage industrialization, government banks extended loans to prospective industrialists and guaranteed payment for imported machinery; the government gave industrialists preferential exchange rates for the purchase of factory machinery, granted tax exemption for imported items and tax holiday to get the factory on its feet. Unwittingly, this encouraged the more shrewd of the industrialists to import much of their needs in order to avail of government assistance.[78]

Third, he argued that the short-cuts to industrialization repressed the development of local technology. As he observed it:

> Many of the industrialists, both in the private sector and in government were young, fresh graduates from foreign educational

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[76] Jose R. Velasco, " A Critique of our Science Effort in the Last 25 Years," Fookien Times Yearbook, (1973), pp. 218-221,227.

[77] Ibid., p. 221.

[78] Ibid.

> institutions. Fired with the impatience of youth, they wanted to hasten the pace of development; so they opted for importation of factories on a turn-key basis. This is to cut the time and material wasted in experimentation or costly mistakes. However, this practice deprived local technologists of the experience of putting up factories and the opportunity to improve up-to-date machinery, the technologists (who could service the machines and improvise in case of difficulties) were not easy to come by. Whenever something went wrong with the factory, we had to hire foreign experts to solve the problem; when machine parts became worn out, replacements had to be imported. In other words, the up-do-date factory, put up on turn-key arrangement was operated on a pipeline (as it were) from advanced countries.[79]

To a certain extent, Velasco attributed the adoption of these policies to the fact that government has failed to tap scientist-technologists to help in decision-making. As he observed it: "Before the lawyers ruled and roost; now they share it with the economists. Even in matters strictly concerned with science, policies and decisions are made for the scientist "[80] On the other hand, he pointed out that scientists can not be entirely exculpated from this state of affairs, because:

> In pursuing our researches, we have not thought of the needs of industrialists, nor have we involved them in the science effort. In research, we choose a project because it strikes our fancy, it involves some technique we have learned, the subject is actively explored in foreign laboratories, or it calls for sophisticated equipment. Seldom do we consider the application of the desired findings in some existing local industry. If we think at all of the application, it is with the quixotic ambition of establishing a new industry.[81]

Velasco observed that administrators of technical agencies have somehow failed to make their agencies more effective. He commented that they tend to regard the top position in a technical agency as a "political position". They feel that "they must make outside contact and push the image of the institution through press releases. It seldom occurs to these

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[79] Ibid.

[80] Ibid.

[81] Ibid.

agencies that they have to do their own work."[82]

Compared with NIST, PCARR is more directly involved in the formulation of science policy in agriculture, forestry, fisheries and resources research. Its major functions are to define goals, purposes and scope of research necessary to support progressive development of agriculture, forestry, fisheries and mining; develop the national agricultural research program; establish a system of priorities for agriculture, forestry, fisheries and mining research; and provide meaningful mechanisms for updating these priorities.[83] It is entrusted with the responsibility of programming the allocation of all government revenues earmarked for agriculture and resources research. Compared with NIST, PCARR is more concerned with programming, managing and coordinating research activities rather than conducting its own. As PCARR's Director-General explained:

> As a matter of policy, our staff don't do research for the sectoral areas but most of the researches that they would do would be on research management. Out of 950 on-going projects in the country, only two or three are done under the leadership of our staff.[84]

Both the NIST Commissioner and PCARR Director-General are aware of the need to be active participants in policy-making for the development of scientific research and its utilization for socioeconomic progress. The NIST Commissioner pointed out that an administrator has to be alert in watching out for policies that may have important,or even adverse re-

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[82] Interview with Velasco, 10 March 1977.

[83] Presidential Decree No. 48, 10 November 1972, as amended by P.D. No. 864, 29 December 1975.

[84] Interview with Dr. Joseph C. Madamba, Director-General, PCARR, U.P. at Los Baños Campus, 13 May 1977.

percussions for his agency's program. He noted that this could happen under the old Congress as well as under the present system of legislation. For example, he explained that NIST has long been doing testing, calibration and standardization work for the country. However, before Martial Law was declared, some people in the Department of Trade thought that since the Bureau of Standards in the United States is under the Department of Commerce, testing and calibration in the Philippines should be similarly organized! Thus, he recalled, they were able to get a law enacted by Congress to create a Bureau of Standards under the Department of Trade. As the Commissioner recounted:

> We were caught flatfooted. Now the Bureau of Standards is trying to do testing and calibration but they do not have the equipment, let alone the manpower. Recently, they were proposing the internal reorganization of the Deparment of Trade which in effect would have taken away all of our functions of testing and standardization. We got wind of it and we stopped them at the hearings of the Commission on Reorganization.[85]

The Director-General of PCARR was responsible for drafting the presidential decree that created the agency. He said that the draft decree was reviewed by the Secretary and Undersecretary of Agriculture. It was also shown to the NSDB Chairman. It was then taken to the President of the Philippines for his signature by the Secretary of Agriculture.[86] Madamba went on to explain that the creation of PCARR was also discussed with the Commission on Reorganization. This was before the drafting of the decree. PCARR's linkage with NSDB is the NSDB Chairman who also sits as Chairman of the PCARR Governing Council. PCARR, according to its

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[85]Interview with Velasco, 10 March 1977.

[86]Interview with Madamba, 13 May 1977.

Director-General, has a separate budget from NSDB but the agency must relate its work to the overall science picture.

At the time of my interview, Madamba revealed that the inter-agency committee which had been earlier created by PCARR Governing Council to study and prepare a revised auditing manual for research had completed its work. He said this was aimed at removing one of the bottlenecks in implementation of research projects. As he put it:

> Those provisions in the proposed manual which fall under the authority of the Chairman of the Commission on Audit and which can be revised by Memorandum Circular have now been put under a Memorandum Circular. The other aspects which need presidential action have now been put into a presidential decree which will be presented to the President. All these have taken 10 months. The Chairman of the Commission on Audit said that it is his responsibility to take it to the President and follow it up.[87]

In evaluating and monitoring the implementation of research projects, PCARR not only looks at the technical aspects of a project but also on its budgetary aspects. PCARR sees to it that what is appropriated for research is used for research and not diverted for other purposes. This is done through the budget release mechanism. PCARR works closely with the Budget Commission in this regard. Asked about the reaction of agencies to this function, Madamba said:

> The research group seems to welcome this because they find that they are getting more funds. The administrator group is reluctant because this means that there are people who will be looking over their shoulders when they do research. The other thing is that some agencies look at this mechanism as a possibility for really getting substantial support, so they welcome this. Others look at it as a threat especially among the colleges and universities. They can no longer use funds for other purposes.[88]

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[87] Ibid.

[88] Ibid.

He believed that there is need to develop this response mechanism of PCARR further. As he put it:

> The policy people have to look at this matter of developing this response mechanism because I do feel that research should be used as a tool for national development. The development phase of developing countries is fast and very dynamic. The response mechanism has to be much faster. We cannot afford a situation where the normal academic atmosphere is followed.... The reason why PCARR had to come in and do some research is because some agencies were either too busy or not interested. If there is such a problem, there must be a mechanism to do it. The budget clout is not enough because in the budget, you go over it once a year. By the time they implement it, another year has passed and still another by the time you evaluate the project. The time lag is two years.[89]

Perceptions About Education and Training of Scientists and Engineers

The NIST Commissioner, Science Research Chief of the Biological Research Center of NIST and PCARR Director-General shared the views of NSDB administrators that there is still great need for highly trained scientists and engineers in the country, particularly in government science agencies. As Commissioner Velasco expressed it:

> We have to fight on two fronts. We have to be a go-getter to make sure we get qualified people. We have to fight the floodgates of unqualified people. Once they are recruited, we have to train them under some kind of apprenticeship if we can.[90]

Velasco discussed some problems about chemistry graduates in the country. Many of them are products of private schools and are generally better prepared for passing chemistry board examinations. He revealed that the Chemistry Board of Examiners have been discussing with them at NIST the possibility of requiring a minimum complement of equipment for

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[89] Ibid.

[90] Interview with Velasco, 10 March 1977.

degree granting institutions in chemistry. He thought that such a policy would be very hard to implement because private institutions have to think of their stockholders. He thought that if government really thinks that these private institutions are contributing to development, it should help them in this respect. He argued that "in a country like ours, we should have researchers whose preoccupation is research, and training degree students is incidental." Like former NSDB Chairman Medina, he is in favor of apprenticeship training in research. He believed that one reason for the slow growth of science in the country is that:

> We have not generated a corps of "elder statesmen" in local science, who could mould the young scientists and steer the scientific effort to the more relevant enterprises....the present crop of scientists is allowed to pursue independent research after having earned some units in a technical subject. Much funds, facilities and equipment are placed at his disposal. No experienced person or a peer evaluates his performance. In this state of laissez faire no scientist is expected to inquire how effectively a fellow scientist has utilized resources.[91]

The NIST and NSDB had a joint Technical Laboratory Training Program from 1963 to 1972 which trained 629 college graduates in the physical and biological sciences and engineering. According to Velasco, one difficulty with continuing the program was that it required a lot of man-hours of NIST's staff. He felt it would be preferable for NIST to train these graduates once they are in its employ.

Regarding the brain drain problem, Velasco revealed that some NIST scholars sent abroad for advanced training returned to the agency only as a token gesture. They then offered to pay the balance of their contract and got out of the agency. He said:

> Sometimes, kiddingly, I say I regret sending them for training because that is the fastest way of losing them either

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[91]Velasco, "A Critique of our Science Effort in the Last 25 Years," op. cit., p. 221.

internally (within the country) or externally.[92]

The Commissioner explained that sometimes trained people have been lost to industry because of Civil Service and WAPCO rules. As he put it:

> Being under the Civil Service, we can't accelerate salaries of highly trained staff as fast as we would like to. This is because of WAPCO and Civil Service Rules. If we accelerate them too fast, we get protests. We can't give them a made-to-order job, we also have to wait for the next budget. If a person is in a hurry (to improve his position) and it is cluttered with obstacles, he starts looking around.[93]

The Science Research Chief of NIST's Biological Research Center cited cases of its highly-trained staff who have been lost to the University of the Philippine and private industry. Some of the lower level staff have also been lost to pharmaceutical laboratories and the U.P. Many who have decided to emigrate to other countries are mostly Bachelor of Science graduates, like pharmacists who become medical technologists in the United States. He revealed that they had difficulty recruiting scientists at the level of Science Research Associate III and above. As he put it:

> This is the level where we expect independence in research work, i.e. they can propose and design their own projects. The minimum qualification for this is a Master of Science.[94]

He gave as reasons for this the low salary scales and the work situation in research institutions which are not very attractive.

Commenting on the brain drain problem, Kintanar said that the reason

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[92]Interview with Velasco, 10 March 1977.

[93]Ibid.

[94]Interview with Dr. Quintin Kintanar, Science Research Chief, Biological Research Center, NIST, Manila, 10 March 1977.

many physicians go abroad is that there are no strong residency training programs or specialist training programs in the country. Most specialists are trained abroad. Even the residency program at the University of the Philippines College of Medicine is not really well-developed, in his view. He observed that doctors consider it only as a stepping stone; they still consider training abroad as necessary and superior to local training. Because of this, he said, that the Philippine Medical Association has asked all specialty associations to design their own residency training programs to be instituted at Medical Centers. These will be accredited by PMA as approved programs.

On the training of medical scientists in the country, Kintanar revealed that only the University of the Philippines had an M.S. program in Biochemistry, Physiology and Pharmacology. He commented:

> There is a real need to develop our capability to train our medical scientists up to the Ph.D. level. We recommended a graduate program to U.P. which should be heavily funded. It would need laboratory facilities, fellows and scholars. There is a real need for this as graduates of Bachelor of Science can't do independent research.[95]

He discussed a plan, which he helped to prepare, to put up such a program within the University of the Philippines based on a pooling of resources and manpower. The graduate program in basic medical science -- anatomy, pathology, biochemistry and physiology -- would be up to the Ph.D. level, with emphasis on a specific department. This was submitted in 1973. It was a new program that was to provide faculty members with advanced training in basic medical science for all medical colleges in the Philippines and for researchers in universities and government research

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[95] Ibid.

institutions and, perhaps, private industry. However, it has not been implemented for lack of funding. In the meantime, three or four of the people who had been expected to man the program had already emigrated to the United States.[96]

The PCARR Director-General emphasized the need for highly-trained manpower in the agricultural sciences. PCARR has its scholarship program which hopes to train about 400 Ph.D., 1,000 M.S. and 400 B.S. degree holders. Most of these will be trained locally as the University of the Philippines at Los Baños has already the capability for graduate education in this field. In the allocation of scholarships, a bias was introduced in PCARR against UPLB Staff, that is , only 20 per cent of the slots would be given to them. The 80 per cent would be made available for the rest of the agricultural research network. He explained:

> The rationale here is that UPLB has a lot of trained manpower already and that invariably if you just look at it on a grade basis, most of the people would be coming from UPLB. We had to inject a definite bias towards the building up of the total national agricultural research system.[97]

Like the other science administrators, Madamba believed that the capability to train high level science manpower should be developed in the country. This is because he felt that Ph.D. training abroad, especially in the United States has an elitist and conservative bias. He observed that some Ph.D.s trained in the United States still want to consult their peers there before they would release the results of their experiments in the Philippines.[98]

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[96] Ibid.

[97] Interview with Madamba, 13 May 1977.

[98] Ibid.

Summary and Conclusion

The preceding examination of perceptions of NSDB administrators about the goals of science policy, education and training of scientists and engineers, and problems of science policy implementation revealed the increasing concern with making science relevant to the country's needs and conditions. NSDB's program of scientific research and activities has increasingly focused on food production, nutrition, rural development, energy development and the like. These reflect also the general policy goals of successive national government administrations. The present administration's emphasis on science and technology as instruments of social and economic development and the urgency which it places on achieving a New Society has compelled science administrators to re-examine the goals and directions of their programs.

The NSDB administrators were aware of the need to look at the interrelationships between NSDB, its agencies and other government departments, between NSDB, universities and colleges and the professional and scientific societies, and between NSDB and private industry. They recognized the need to direct scientific research towards development of industries using indigenous raw materials. While they have all been exposed by their training to the uses of science in industrialized countries, they recognized that the application of scientific research and development to the Philippines has to be related to sociocultural and economic realities.

Other science administrators I interviewed shared similar views on the need to relate their agency programs and activities with those of relevant government agencies, universities and colleges, professional societies and the private sector. They were very conscious of the need to review science policy, particularly on the education and training of scientists and engi-

neers, in order to promote the advancement of Philippine science and technology for fostering social and economic development. Along with NSDB administrators, they believed that universities and colleges, both state-owned and private, should be aided by government to strengthen academic programs in the sciences and to develop their capability to provide graduate training in the sciences and engineering. As these programs can be closely geared to local conditions,their development would obviate the need for advanced training in foreign countries and thus help minimize the emigration of highly-trained scientists and engineers.

It was apparent from my interviews that science administrators shared similar perceptions about the problems of formulating and implementing policies for the development of science and technology in the country. The government's lack of attention to development of science in earlier years appears to stem from the failure of policy-makers to relate the consequences of economic policies on science and education policies and vice versa. This in turn may be partly explained by the formal education and training of scientists who become administrators. As scientists and researchers, they lacked understanding of the dynamics of policy-making and administration. As such, they had not been able to persuade policy-makers of the necessity for changing some of the bureaucratic structures and regulations which they felt were inimical to the advancement of science and technology. With the change in administrative setup since 1972, and government's active concern on the role of science in national development programs, scientist-administrators have become more involved in policy-making. It remains to be seen whether they can make more active contribution in relating science policy with other government policies -- economic, social and others -- with their increasing involvement in development planning.

The next chapter will examine the perceptions of educators on science policy and the education and training of scientists and engineers.

Chapter VIII

Science Policy and the Education and Training of Scientists and Engineers: Perceptions of Educators

The material for this chapter is derived from interviews and questionnaires administered to educators from 12 institutions of higher education (six private and six state-owned) located in seven of the country's 12 administrative regions. The seven regions contained 68.5 per cent of total population as of 1 May 1975. The interviews and questionnaires were aimed at getting insights into the operations of different types of colleges and universities with science and engineering programs, their relationships with the Department of Education and Culture and science policy-making bodies such as NSDB. The government's goals in its long-term development plan for the year 2000 as discussed in Chapter I included, among other things, self-reliance in basic needs, a high level of industrialization, rural and regional development, and resource adequacy and development. Thus this Chapter will also examine how the colleges and universities in various parts of the country are contributing to the education and training of high-level manpower, particularly in science and engineering, which will be needed to attain the nation's goals. The universities and colleges in which the survey was conducted represented a variety of settings -- metropolitan, urban and rural.

Institutions Represented in the Survey*

U.P.: State University in the Metropolitan Area. The University of the Philippines System in the Metropolitan Manila Area is the country's oldest and largest state university with the most comprehensive programs

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*Further details are found in Appendix B.

of study in science and engineering. Its main campus is located in Diliman, Quezon City where its colleges of Arts and Sciences, Engineering, Fisheries, Home Economics, Pharmacy, Veterinary Medicine and other professional institutes and schools are found. In the same campus are several science research centers: Natural Science Research Center, Science Education Center, Marine Sciences Center, National Hydraulic Research Center, Engineering Industrial Research Center and others. The colleges of Medicine and Dentistry, Institute of Public Health,School of Allied Medical Professions and other units are found in the old campus in Manila.

The U.P. at Los Baños is an autonomous university in the U.P. System. Located some 60 kilometers south of the Metropolitan Manila Area, it began as the U.P. College of Agriculture in 1908. It became an autonomous university in 1972. Since then, it has grown into several colleges and institutes offering degree programs in the agricultural and natural sciences, forestry and agricultural engineering.

Several research units have been established within the U.P. at Los Baños: Dairy Training and Research Institute, Institute of Plant Breeding, Animal Science Center, National Crop Protection Center, and a number of centers for research in agrarian reform, cooperatives, and policy and development studies. The International Rice Research Institute, a privately funded research and training center serving Asian countries, the Forest Products Research and Industries Development Commission (FORPRIDECOM) of NSDB, Philippine Council for Agriculture and Resources Research (PCARR), and Southeast Asian Regional Center for Graduate Study in Agriculture (SEARCA) are also located in the campus of U.P. at Los Baños. UPLB provides the faculty of instruction and resource persons for SEARCA activities and programs. SEARCA, in turn, grants financial assistance to UPLB in the form of profes-

sorial chairs.[1]

Regional Colleges and Universities. The Isabela State College of Agriculture (ISCA) provides a contrast to UPLB. It is a small, recently chartered state college (1972) located in Echague, Isabela province. Isabela is part of the country's least populated region, Cagayan Valley, but is its biggest and most populated province. ISCA began as an intermediate agricultural school in 1923 and grew into its present status as a chartered state college. It is presently one of two state colleges in Isabela, the other one being the Cagayan Valley Institute of Technology. ISCA, with an enrollment of 4,678 in school year 1976-77 (2,989 undergraduate and graduate, and 1,689 secondary school students) is the biggest state college in the Cagayan Valley region (Region II) as well as the entire Northern Luzon.[2] There are no private or state universities in the Cagayan Valley. However, there are several state and private colleges as well as public vocational/technical schools.

The Central Luzon State University (CLSU), like ISCA, is located in an agricultural area, three kilometers from the town of Muñoz, Nueva Ecija. Nueva Ecija, together with the other provinces of Central Luzon region (Region III), make up the central plains of Luzon which is the country's traditional rice basket. Sugar is also an important crop in the area especially in the provinces of Pampanga and Tarlac. In the region are found, aside from CLSU, one private university, five state and 44 private

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[1] "American, Asian Educators Applaud UPLB-SEARCA-IRRI Development Efforts," The UPLB Horizon, Vol. III, No. 8 (August 1975), p. 1.

[2] Isabela State College of Agriculture, Ten-Year Development Plan, 1976-1977 to 1985-86 (Echague: 1976, mimeo.), pp. 1-4, 52.

colleges, several public vocational/technical schools and community colleges. CLSU's program thrusts in science and technology are focused primarily on agriculture and related industries.

In the Visayan islands, the colleges and universities included in the survey were from Iloilo City in West Visayas (Region VI) and Cebu City in Central Visayas (Region VIII). Iloilo City is the third largest city in the country outside the Metropolitan Manila Area. Its population in 1970 was 200,000, representing 1.7 per cent of total urban population.[3] There are several institutions of higher learning in the city: U.P. College Iloilo, West Visayas State College, University of San Agustin, Central Philippine University, and University of Iloilo. The last three are private institutions.

The U.P. College Iloilo is a regional unit of the University of the Philippines System. West Visayas State College (WVSC) was originally the Iloilo Normal School founded in 1924, one of eight pioneer public normal schools in the country for the training of elementary school teachers. It was converted into a state college by Republic Act No. 4189 (4 May 1965). WVSC has embarked on a consortium (since 24 September 1974) with U.P. College Iloilo and Central Philippine University in order to "ensure quality education at minimum cost by a sharing of resources, faculty and facilities as well as to find worthy causes for joint ventures in research and community services which require the cooperation of institutions of higher learning."[4] In 1974, WVSC was designated as Regional Staff Development

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[3] The Philippines: Priorities and Prospects for Development, A World Bank Country Economic Report (Washington,D.C.: The World Bank, 1976), Table 3.1, p. 43.

[4] West Visayas State College, Bulletin of Information,1976 (Iloilo City: 1976), p. 2.

Center under the Educational Development Projects Implementing Task Force (EDPITAF) of the Department of Education and Culture. The College is also Regional Science Training Center for elementary and mathematics teachers for Eastern and Western Visayas.

The University of San Agustin and Central Philippine University in Iloilo City are private sectarian universities. The University of San Agustin is run by the Augustinian Fathers (of the Province of the Most Holy Name of Jesus of the Philippines). The school was opened in 1904, expanding gradually and became a university in 1953. Its average annual collegiate enrollment for school years 1972-73 to 1976-77 was over 8,100.

Central Philippine University (CPU) was founded in 1905 by the Foreign Baptist Mission in the United States. Its programs grew over the years and was granted university status in 1953. CPU is run by the Baptist Church in the Philippines. Its collegiate enrollment in school year 1975-76 was 5,200 students. CPU's College of Engineering was selected in 1977 by EDPITAF as one of 20 engineering schools which will participate in the government's program of reforming and upgrading engineering education. The government will assist CPU by extending it soft, long-term loans which the latter will use to finance its laboratory equipment, facilities and the advanced training of its engineering faculty and administrators.

For the Central Visayas region, two schools in Cebu City (U.P. College Cebu and University of San Carlos) were included in the survery. Cebu City is the country's second largest city outside the Metropolitan Manila Area. Its population in 1970 was 347,000, representing 2.9 per cent of total urban population.[5] As of school year 1976-77, there were four private

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[5] The Philippines; Priorities and Prospects for Development, loc. cit.

universities in Cebu City of which the University of San Carlos (USC) is the oldest and biggest in enrollment. USC is the second largest of 12 Catholic universities in the country.[6] Its total enrollment in school year 1976-77 was 15,711, of which 10,232 (65 per cent) were in the undergraduate and graduate programs. USC was founded in 1595 by Jesuit missionaries. In 1935, the management of the school was taken over by the Divine Word Fathers (SVD). San Carlos became a university in 1948. The University has several research centers and training units such as the Hydrological Research and Training Unit, Marine Biology Station, and others.

Xavier University, located in Cagayan de Oro City, was chosen for the survey in Northern Mindanao region (Region X). Cagayan de Oro is the ninth largest city outside Metropolitan Manila Area, with a population of 124,000 in 1970, or 1.1 per cent of total urban population. Owned by the Jesuit Fathers, Xavier University is the only private university in the region which has 38 private colleges and two state-owned schools (a college and a university in the province of Bukidnon). There are five other private colleges in Cagayan de Oro City. Xavier University was founded in 1933 as the Ateneo de Cagayan and became a university in 1957. As of school year 1975-76, the University had a collegiate enrollment of 2,700 and 147 faculty members.

For the Southern Mindanao region (Region XI), two schools -- the University of Mindanao and Ateneo de Davao College -- in Davao City, were included in the study. Davao City is the largest city outside Metropolitan Manila Area with a population of 392,000, or 3.2 per cent of total urban

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[6]The biggest Catholic university is the University of Santo Tomas in Manila.

population in 1970. As of school year 1976-77, there were two private universities (both in Davao City) and 47 private colleges in Southern Mindanao region. At the time of my interviews, a U.P. College was to open in Davao City.

The University of Mindanao (UM) is a private school organized as a stock corporation. Founded in 1946, it became a university in 1965. The UM campus is in the downtown area of Davao City, just like many private universities in downtown Manila. In school year 1976-77, UM's collegiate population reached 13,000 of which 4,085 were enrolled in engineering courses. In 1960, the University set up a nonstock, nonprofit teaching and research institution, the Mt. Apo Science Foundation. Located in a 100-hectare campus some 30 minutes drive from Davao City's urban center, the Foundation, which is certified by NSDB as a bona fide institution dedicated to scientific education and research, is supported by funds from UM and private donations. Its programs are mainly for undergraduate degrees in agriculture, arts and sciences, forestry and engineering. Most of its students enjoy scholarships which include free tuition, textbooks, housing and meals. Some of the teaching staff are U.S. Peace Corps volunteers, British Volunteers Overseas and Japanese Overseas Volunteers.

The Ateneo de Davao College is a private school run by the Jesuits. It offers undergraduate programs which include, among others, the Bachelor of Science in biology, chemistry, mathematics and agriculture. The College has a consortium with Brokenshire Hospital in Davao City to put up the Davao Medical School, the first such school in Mindanao, to start in school year 1977-78. The medical degree will be granted by Ateneo de Davao College but its faculty, library, laboratory and hospital facilities will be shared with Brokenshire Hospital. The goal of this new medical education program

is to produce doctors for Mindanao rather than Manila or the United States. Hence, its curriculum will be geared to rural medical practice. The students will be selected for admission to the medical school on the basis of intelligence and their commitment to serve in the area.[7]

The Interview/Questionnaire Survey

The interviews/questionnaires were administered to selected aministrators and science/engineering faculty members at the colleges and universities mentioned. A total of 50 individuals were covered by the survey: nine top administrators -- presidents or vice-presidents/vice-rectors for academic affairs or their equivalents, 14 deans of colleges of agriculture, arts and sciences and engineering, and 27 heads of agriculture, engineering and science departments.

The interviews/questionnaires sought to elicit information and opinions on how these institutions related with the Department of Education and Culture, government funding/research agencies and private industry. More specifically, the study sought to answer the following questions: What are the educators' perceptions of government policies on the education and training of scientists and engineers as well as on scientific research? What problems do they encounter in their work of producing their region's and ultimately the country's needed supply of scientists and engineers? What are their perceptions about the relevance and adequacy of the education and training of scientists and engineers in the Philippines? What policy recommendations can be made on the basis of this first hand information?

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[7]Interview with Fr. Emeterio J. Barcelon, S.J., President, Ateneo de Davao College, Davao City, 21 April 1977.

Relations Between Government and Universities/Colleges

State universities and colleges are generally more autonomous than private universities and colleges in the formulation of their course offerings and programs of instruction. They operate within the provisions of their charters and are generally independent of the Department of Education and Culture (DEC). Proposals for new courses and programs of instruction in state schools originate from the departmental or college faculty and are subject to final approval of the school's Board of Regents or Trustees. The Secretary of DEC is usually designated as Ex-Officio Chairman of a state university's (or college's) Board of Regents or Trustees. An exception to this arrangement is the Isabela State College of Agriculture whose President is also Chairman of its Board of Trustees.[8]

The administrators of private universities and colleges felt that they are subject to more regulations and restrictions in curriculum planning than state universities and colleges. They must comply with standards laid down by DEC regarding faculty/staff complement and their qualifications, library and laboratory facilities before they can offer new courses or be recognized as bona fide universities. The private university/college administrators, however, admitted that existing government regulation of private institutions of higher education is necessary to safeguard against schools that are established solely for profit and thus function as diploma mills.

Because of detailed government regulation of private universities/colleges, they are qualitatively better equipped than some of the state colleges. The latter could in the past be created from ill-equipped provincial

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[8]Interview with Dr. Felipe Cachola, President, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

vocational/technical schools by mere legislation from Congress. Moreover, the recruitment of qualified faculty/staff of these new state colleges was often hampered by political interference, that is, patronage by members of Congress and provincial officials. This is what happened, for example, to the Isabela State College of Agriculture. The incumbent President of ISCA revealed that one of his problems when he assumed office in 1976 was the lopsided distribution of the College faculty in terms of training and qualifications vis-a-vis the requirements of degree programs. There were more faculty members with general education backgrounds than technical/scientific professional qualifications. ISCA President Cachola explained that he had to phase out two baccalaureate programs (in mechanical engineering and animal husbandry) since there were not enough faculty qualified to teach the required courses.[9]

Among administrators of private universities/colleges, there was a general acceptance of the necessity for quality control by government over private educational institutions. Nevertheless, the consensus was that the Department of Education and Culture should be more selective in imposing its regulations. For example, in matters of curriculum, my interviewees contended that DEC should allow more autonomy to private universities and colleges that have proven themselves to be serious educational institutions through their maintenance of high academic standards in the past. There was the general feeling that DEC was too restrictive in regulating curricular offerings or programs.[10] The President of Central Philippine Univer-

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[9] Ibid.

[10] One university president, for example, cited a proposed course in "Modern Europe" which they sent to the DEC for approval. The proposal was returned to the school with a DEC note that the course offered must be "Contemporary Europe."

sity in Iloilo City cited as an example of this problem a request for DEC approval of a Master of Science in Nursing program designed for deans of nursing schools. The proposal was aimed at giving the deans more exposure in management and administration. DEC modified the program by specifying more professional content. The CPU President felt that their proposed program could have been better for the needs of the region if they had been allowed to do it their own way.[11]

The DEC prescribes the minimum laboratory and library facilities for which private universities and colleges should have to get permits to offer science and engineering courses. These facilities are subject to inspection by DEC personnel. The private university/college administrators felt that DEC had insufficient staff to carry out this function effectively. Moreover, many of its inspectors lacked the expertise to perform their tasks. One engineering dean observed that the DEC section responsible for the enforcement of library/laboratory requirements for 98 private engineering schools in the country was undermanned. Another noted that:

> The DEC requires laboratory equipment for engineering schools which are good for commercial purposes, and hence, very expensive. However, in our interviews with foreign visitors (on engineering education) we found out that in more modern countries they have only bench models in their laboratories. The bench model of a commercial boiler, for example, costs only ₱2,500 while the commerical model costs ₱100,000.

One private university president (a Ph.D. in chemistry) related that one inspector sent by DEC to evaluate their chemistry laboratory did not have the necessary background to check their equipment against the objectives of their proposed course. He commented:

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[11] Interview with Dr. Agustin Pulido, President, Central Philippine University, Iloilo City, 25 April 1977.

> They tend to have a clerical mentality when they look at these matters. Hence, because of the constant battling by private schools with DEC bureaucracy, many of us have not been very enthusiastic in starting new programs. The general perception we have is that it is a long tortuous trail to get our curriculum approved by DEC.

The abolition of the Bureaus of Private Schools and Public Schools and their replacement by the Bureau of Higher Education at DEC in 1973 integrated the supervision of both private and public institutions of higher education in the country. This has partly allayed the feeling among private university/college administrators of discrimination in the enforcement of government regulations. Along with the reorganization, Regional Offices of DEC were created. I gathered from the interviews that administrators of private universities/colleges still go to the central office in Manila to follow up many of their papers such as, for instance, special orders for the graduation of students.

The survey revealed that DEC tended to consult the more established private universities in certain areas of policy. This was apparent in my interviews with officials of the University of San Carlos, Xavier University and Central Philippine University. They related that they had been made members of government study committees or task forces on certain problems, including the preparation of their region's long-term development plan. The general feeling of the administrators of private universities/colleges, however, is that they were often left out of policy-making in education. This is particularly true on the establishment of new state colleges in the provinces. As one administrator commented:

> The government should look at how it can assist existing private universities/colleges in the regions to strengthen their programs instead of opening additional state schools in the same areas where the former are already established. This would lead to considerable savings in government funds and also higher standards of instruction. As it is, we are not consulted in these matters. The government's resources such as qualified manpower are spread out thinly.

Among administrators of state universities and colleges, the President of the University of the Philippine System participates directly in educational policy-making as member of DEC's National Board of Education and in science policy-making as member of NSDB's Board of Governors. The Chancellor of the University of the Philippines at Los Baños similarly participates in decision-making on agricultural and resources research as member of the Governing Council of the Philippine Council for Agriculture and Resources Research (PCARR).

Funding of Scientific Research in Universities/Colleges

The interviews revealed that research was being done in the natural sciences and engineering in 10 out of the 12 institutions surveyed. These were in the six state-owned schools and four private universities. All the educators interviewed were aware of the sources of government funding for scientific research in the country. Three agencies were mentioned by all respondents when asked if they knew of any government agencies to which they could apply for research funds. These were the National Science Development Board (NSDB), Philippine Council for Agriculture and Resources Research (PCARR) and National Research Council of the Philippines (NRCP). Two physicists also mentioned the Philippine Atomic Energy Commission. In addition, natural scientists working at the University of the Philippines and Central Luzon State University mentioned such sources of government funds for applied research as the National Food and Agriculture Council (NFAC), Departments of Agriculture and Natural Resources (DA and DNR), commodity research institutes such as Philippine Sugar Institute (PHILSUGIN), Philippine Coconut Authority (PCA), and others.

When asked whether they knew of any private organizations or foundations to which they could apply for research grants, 22 of the 27 chairmen of

science departments interviewed answered yes. Fifteen of the 22 were specialists in the biological and agricultural sciences. The interviewees were asked to name private organizations which they knew were giving research grants in the sciences and engineering. Twelve organizations were mentioned by the respondents, three of which were foreign foundations: Asia Foundation, Ford Foundation and International Foundation for Science in Sweden. Two Philippine corporations were frequently mentioned by several respondents -- San Miguel Corporation and Ayala Corporation. The Filipinas Foundation, which was set up by the latter corporation was frequently mentioned as a source of funding for scientific research. The other corporations mentioned were mostly chemical companies, usually subsidiaries of multinational firms, such as Union Carbide, American Cyanamid, Mantrade Chemical Division and others. As one scientist from the Central Luzon State University explained:

> Almost all private chemical companies are potential sources of funding for research. At present, I am a cooperator of about 16 chemical companies on field pesticide evaluation.

A similar comment came from an entomologist at the University of the Philippines at Los Baños:

> Chemical companies which want to know how effectively their products can be used usually give research grants. They do this by means of a memorandum of agreement with the university.

Twenty-eight scientists in the ten schools with ongoing research projects were asked to give the sources of funding. Fourteen institutions were mentioned by the scientists, ten of which were government agencies. PCARR was mentioned by 11, NSDB by nine, NRCP by four, the Deparment of Agriculture by three, and the Department of Natural Resources by two scientists. Four government commodity research institutes were named by agricultural scientists. Two international foundations were given as currently funding

research projects: International Rice Research Institute and International Foundation for Science. Among the private corporations which were funding current researches in 10 of the 12 schools covered by the survey were San Miguel Corporation, Marcelo Fertilizer Co., Hoechst (Philippines), Cyanamid (Philippines), and Union Carbide. Some scientists at the University of the Philippines revealed that their departments had several ongoing research projects with different sources of funding.

Among the schools surveyed, only the University of the Philippines College of Engineering had continuing research projects in the engineering sciences. This is in part due to the concentration of highly-trained engineering faculty in that institution as well as the availability of research facilities and money for engineering research. Of its 72 full-time faculty members in 1976-77, 26 (36.1 per cent) were master's degree holders and 18 (25 per cent) were Ph.D. holders. In the four other engineering colleges covered by my survey (three had been chosen by EDPITAF to form part of the government project of upgrading engineering education), there were very few Master's degree holders and no Ph.D. holders among their full-time faculty. There were 17 engineering research projects at the U.P. College of Engineering funded by eight agencies in school year 1976-77. Five of the projects were sponsored by NSDB, three by NRCP, two by the UP-NSDB Graduate Manpower Program, two by the Research and Development Center of the Armed Forces of the Philippines, one by the Philippine Navy Communications and Electronics Office, two by funding agencies in the United States, and one by the International Atomic Energy Commission.

As could be expected, the University of the Philippines at Diliman and at Los Baños, because of the concentration of the country's highly trained scientists and engineers in their faculty and staff, had the

biggest number of research projects in a variety of scientific fields among the schools surveyed. The University of the Philippines System, since 1972, has an institutional arrangement with NSDB on the funding of scientific research by its faculty and staff. This is the NSDB-UP integrated Research Program which,in 1976-77, amounted to ₱7 million. Of this amount, 60 per cent was allocated for researches at U.P. in Diliman and 40 per cent went to the U.P. at Los Baños.[12] Research proposals under the NSDB-UP Integrated Research Program are jointly evaluated by the University's research coordinators and NSDB. In addition to this program, NSDB funds other projects at the U.P. System. These are the Integrated Academic Program in the Sciences (INTAPS) at the U.P. at Los Baños, UP-NSDB Graduate Manpower Training Program, and UP Science Education Center. The first two projects are designed to help ensure the country's supply of highly-trained scientists and engineers; the third is aimed at upgrading science teaching and the preparation of science textbooks and equipment for elementary and secondary schools.

A problem that was revealed in my interviews was NSDB funding for research proposals coming from the U.P. System's regional units. A faculty member in the biological sciences at the U.P. College Cebu, for example, related that she submitted a research proposal to the NSDB Regional Office in Cebu City in 1976-77. The NSDB's Regional Office evaluated and approved the proposal. Assured of funding, the researcher started work on the research project. Several months later, however, the researcher was informed by the NSDB Main Office that the project should be funded by

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[12]Interview with Dr. Melecio Magno, Chairman, National Science Development Board, Metro Manila, 16 March 1977.

NSDB-UP Integrated Research Program. The research had to be discontinued while the proposal was resubmitted, this time to the U.P. Office of Research Coordination for inclusion in the NSDB-UP Integrated Research Program.

As can be seen from my findings, scientific research in Philippine universities and colleges is funded by government and the private sector. Government funds for research tended to go mostly to state universities and colleges, especially the University of the Philippines. Private funding of scientific research in universities and colleges generally came from two sources: private corporations and foundations. The latter consists of foreign (Ford, Rockefeller Foundation, etc.) and local organizations. Under Section 24 of the Science Act of 1958 (Republic Act No. 2067, as amended), individuals, firms and educational institutions are encouraged to donate funds to support scientific research and development projects. Such donations are tax-exempt provided they are duly certified by NSDB. This has given rise to the establishment of private science foundations, organized as nonstock and nonprofit institutions. These foundations support scientific research and development projects and/or provide scholarships and professorial chairs in universities and colleges. As of July 1977, NSDB had certified 137 private science foundations which must spend at least 51 per cent of their gross income to undertake or finance scientific research, scholarships and professorial chairs in the natural sciences and engineering as well as in the social sciences. NSDB's certification is renewable every five years.[13]

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[13]Republic of the Philippines, National Science Development Board, 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.); NSDB, Committee on Science Foundation, "List of Foundations certified by the National Science Development Board," (1977 , mimeo.).

The University of the Philippines and several private universities have set up their own foundations to finance research projects of their own faculty and staff. Some private schools which have research foundations are the Ateneo de Manila University, Centro Escolar University, De La Salle University, University of Santo Tomas, San Beda College and Aquinas University (jointly with the Legaspi Diocese in the province of Albay). Among the schools studied, the U.P. College of Engineering had an Engineering Research and Development Foundation, Inc. which finances researches in engineering and related sciences. The Xavier Science Foundation, Inc. of Xavier University was established with university funds and private donations. It has been used mainly to support agricultural research by the faculty, although its articles of incorporation cover other scientific disciplines. Ateneo de Davao College has its own Science Research Center, Inc., a foundation set up to support studies for the promotion of science education and grant scholarships in the natural sciences. University of Mindanao's Mt. Apo Science Foundation has been mentioned at the beginning of this chapter. Scientific equipment needed for research projects which are imported into the country by the research foundations is usually tax exempt upon application. Before 1972, NSDB examined applications for tax exemption and certified that equipment was needed for scientific research and instruction. This function is now performed by the Department of Finance and the National Economic and Development Authority (NEDA).

The administrators of private universities and colleges discussed some problems that were encountered in securing scientific equipment for classroom laboratories and research projects. Much of this equipment had to be ordered from other countries as the suppliers in Manila often did not have sufficient stocks. Aside from being expensive, the purchase of scientific

equipment also entailed a lot of the administrators' time as they had to follow up tax-exemption certificates with the central government in Manila. As one Dean of a College of Agriculture commented:

> The government generally accepts the recommendations of UNESCO or one of the American foundations like Ford, Rockefeller or Asia Foundation that the imported scientific equipment should be given tax exemption. We go to the UNESCO office for the necessary papers. These are then presented to the Department of Finance for approval. The Finance Department may ask the NEDA whether these are really bona fide tax-exempt items.

There were often delays in implementing academic and research programs in the sciences because of the time-consuming follow-up of papers and tax clearances for imported equipment. Moreover, administrators in the Visayas and Mindanao revealed that the laboratory equipment that they import and foreign scientific journals to which they subscribed were often lost along the way. The Dean of the Xavier University College of Agriculture stated that in 1975-76, a shipment of laboratory equipment worth ₱18,000 (about US$2,500) never reached them from Manila. In another year, ₱12,000 (about US$1,800) worth of equipment was lost. This is something which administrators of private universities and colleges felt that government should look into if it wants to encourage and assist private institutions to provide quality instruction in the sciences and improve existing research capability.

Views on Government Funding of Scientific Research

There was a general awareness among administrators of regional schools (both state-owned and private) that most of NSDB's research funds went to academic institutions that had well developed science programs and strong science and engineering faculty, particularly the University of the Philippines System. While this was understandable to all of them, some thought that NSDB should explore ways of using its research funds to help develop the staff and research capabilities of regional and provincial universities

and colleges. As one administrator of a regional school commented:

> The NSDB should distribute its funds for research projects. It should send teams to see other institutions as there are more deserving institutions. It seems that only the same schools get funding for research.[14] NSDB should give maximum publicity for its programs so that more deserving and qualified people will know about opportunities for advancement in their fields.

Similarly, one interviewee remarked that PCARR gives more emphasis to regional centers of the national agricultural research network. He recommended that PCARR should distribute its funds for research projects by giving maximum publicity for its programs. In this way, qualified scientists outside the regional centers will have better access to PCARR's research programs.

One scientist in the University of the Philippines expressed criticism of the NSDB-UP Integrated Research Program. He said:

> I was not in favor of the NSDB-UP Integrated Research Program when it was being discussed at NSDB. The program in effect is making use of NSDB funds to develop the faculty and staff of U.P. While this is good for us at U.P., I don't think that this is what NSDB should be doing. There has been no direct relationship between NSDB-funded research projects of the staff and the graduate manpower training program in the sciences. I haven't seen graduate students being encouraged to work with these projects in order to develop their own theses research along related problem areas.

An engineering dean in the Visayas stated that NSDB does not inform them of its research priorities. However, he commented that they can still easily approach NSDB for funding of their research. He mentioned one faculty member who got NSDB funding for his thesis research on pollution for the Master of Science degree. On engineering research, he commented:

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[14] This is similar to the situation in the United States. Merton calls this "The Matthew Effect in Science." See Robert Merton, The Sociology of Science, ed. with an Introduction by Norman Storer (Chicago, Ill.: University of Chicago Press, 1973), esp. pp. 457-458.

> Engineering research should be conducted by private industries. Our private sector is spending only a small amount for research .... What the government should do is to assign to the university sector certain areas of research. Individual universities would then be asked to select the area of research that they are competent to do, with government funding.

Aside from the question of spreading NSDB research funds among state and private universities/colleges in various parts of the country, the issue of funding more basic research was also brought out by the interviewees. One physical scientist at the U.P. at Los Baños related how he submitted a research proposal to NSDB.

> The NSDB thought that my proposed research was too basic, hence I had to withdraw it. However, I was able to get funding from the University for my research which is now on the second year of its four-year timetable. Part of my proposal has also been used for students' thesis research.

A physical scientist in U.P. at Diliman also expressed frustration at getting research support from NSDB. As she put it:

> I did not teach during the whole summer last year just so I could prepare a research proposal. They turned down my proposal because it was basic research. It is true that it is basic in nature but it concerns a problem that is specific to our particular ecology and economy and would, moreover, be eventually needed in our search for alternative sources of energy. Ironically, I was afterwards made a member of the panel which rejected my proposal. I would suggest to NSDB that it should farm out evaluation of research proposals to panels composed of experts in the field. Then NSDB can just tell the proponent that it has no money to fund his proposal.

Scientists of the U.P. System can get support for basic research from the U.P. Natural Science Research Center (UP-NSRC) which has funds outside the NSDB-UP Integrated Research Program. The UP-NSRC was authorized by Republic Act No. 3887 (18 June 1964) but started acquiring physical facilities only after 1970, when President Marcos personally ordered the release of funds appropriated for its operation. The Research Center provides laboratory facilities, services and financial grants on an annual budget of ₱450,000. In 1974, UP-NSRC provided research opportunities for 38 faculty

members of the U.P. Colleges of Arts and Sciences, Veterinary Medicine, the U.P. at Los Baños and one staff member of United Laboratories, a private pharmaceutical firm. The UP-NSRC's Director pointed out that in view of the Center's tight budget, it could not pay honoraria to its researchers. Of the 38 scientists doing research at the Center in 1974, 25 were not getting any honoraria while the rest were using the Center's facilities for projects funded by honorarium-paying agencies. The UP-NSRC's Director has been advocating increased NSDB support for basic research. He observed that the NSDB-UP Integrated Research Program has been mainly used for applied research. While he could not fault policymakers for this emphasis on present needs, he argued:

> In the long view, this procedure is hardly to be recommended... we may not get the basic information (from other countries) that is useful or necessary to our own applied work. Raw information on coconut or bangus (milkfish), for example, can not be obtained from the laboratories of Europe or America.[15]

The advocates for increased funding of basic research by NSDB and other government agencies have emphasized that they do not question the policy that applied scientific research should receive priority in terms of financial support. This could be seen, for instance, from the remarks of certain participants at the NSDB-sponsored Seminar Workshop on Science Policy, held on 14-15 February 1977 in Metropolitan Manila. Prof. Salvador Gonzales, a theoretical physicist from De La Salle University, for example, pointed out:

> While without disagreeing that we should concentrate on relevant

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[15] B.T. Miranda, "Advancement of Science in the New Society," paper prepared for the Annual Symposium of the Philippine Association for the Advancement of Science (Manila: 29 January 1974, mimeo.), p. 3. The above-mentioned data on the U.P. Natural Science Research Center are from pp. 5-6.

> needs and on national progress on technology, we must also have a little bit of heart for basic science and for people who would like to develop science by pursuing knowledge for knowledge sake.

The Chancellor of the U.P. at Los Baños, Dr. Abelardo G. Samonte, likewise commented:

> At the present time, many of our professors have to stretch their imagination on how they would formulate their research proposals, so that they will be approved by NSDB or PCARR because of the orientation or bias in favor of applied research. I believe in the management of scarcity. We cannot be very extravagant in the use of our resources, but I think that even with our scarce resources, we should not dampen a lot of potential creative power among our academe and other researchers...[16]

Other comments elicited from my interviewees regarding NSDB and other government agencies related to the slow processing of research proposals, delayed release of funds, and slow procurement of needed scientific equipment. These views were expressed mainly by scientists working in the regional universities and colleges. A common complaint was that the preparation of research proposals for NSDB, PCARR or NRCP required too much paperwork. One biological scientist from a university in Mindanao saw this as the bottleneck in the submission of proposed projects to government agencies. Private corporations or foundations, according to several interviewees, required less paperwork for research proposals than government agencies. This is one reason why scientists in the regions feel discouraged about submitting proposals to NSDB and its agencies. A scientist from a university in Mindanao revealed that it took NRCP ten months to process his research proposal. Another scientist from the Visayas commented that they preferred to apply for research funding to private foundations, especially

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[16] National Science Development Board, Seminar-Workshop on Science Policy; Proceedings and Summary Report (Metro Manila: 1977, mimeo.), pp. 41,45.

international foundations. Two scientists from a state college in the Visayas mentioned cases where proposed researches which were previously rejected by certain government funding agencies were later on undertaken by other scientists, sometimes from the same agencies which earlier rejected the original proposals. This was demoralizing to the proponents.

Once projects were approved scientists still had to contend with delays in the release of funds, a problem which they attributed to existing auditing rules. NSDB and NRCP were mentioned as agencies which took a long time to release funds. There was a consensus among the respondents that there should be separate auditing procedures for science funding agencies in order to cut down on the bureaucratic red tape that they encountered.

Academic Programs in Sciences and Engineering

Aside from the U.P. System, the undergraduate degree in the biological sciences like the Bachelor of Science in Biology or Marine Biology was offered by four of the six private universities surveyed -- University of San Carlos, Central Philippine University, University of San Agustin and Xavier University. Only the University of San Carlos offered complete undergraduate programs in the physical sciences, i.e. mathematics, physics and chemistry. The Bachelor of Science in Mathematics was offered by Central Philippine University, Xavier University and Ateneo de Davao College. The survey revealed that outside of the U.P. System and the large private universities in the Metropolitan Manila Area, complete academic programs in the basic sciences, both at the undergraduate and graduate levels (up to Master of Science), were available in Cebu City, mainly at the University of San Carlos. In most other schools, science departments did not offer degree programs but merely served to provide courses required for other professional degree programs in commerce, education, law, humanities, and other fields.

Undergraduate degree programs in the agricultural sciences were offered in three state schools surveyed aside from the U.P. at Los Baños and U.P. College Cebu. These were the Isabela State College of Agriculture, Central Luzon State University and West Visayas State College. Only CLSU offered graduate programs in the agricultural sciences. Among the private universities, Central Philippine University and Xavier University have complete undergraduate degree programs in the agricultural sciences. Ateneo de Davao College and the University of Mindanao's Mt. Apo Science Foundation, have recently started offering the Bachelor of Science degrees in Agriculture and Forestry.

Four private universities surveyed in the regions offered undergraduate degrees in four branches of engineering -- civil, chemical, mechanical and electrical -- and architecture. These were the Central Philippine University, University of San Agustin, University of San Carlos and University of Mindanao. At the time of my interviews, Xavier University and University of San Carlos were discussing consortium arrangements whereby the first two years of engineering programs will be offered by Xavier University and the last three years by the University of San Carlos. The degree will be granted jointly by the two universities.[17] The Bachelor of Science in Agricultural Engineering was offered by Isabela State College of Agriculture and Central Luzon State University.

Two regional schools offered the Bachelor of Science in Pharmacy, (University of San Agustin and University of San Carlos), three offered the Bachelor of Science in Nursing (University of San Agustin, Central Philip-

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[17] Interview with Fr. Ernesto O. Javier, S.J., Rector and Vice President, Xavier University, Cagayan de Oro City, 19 April 1977.

pine University and University of San Carlos). West Visayas State College in Iloilo was the only regional school surveyed which offered the Doctor of Medicine degree. However, Ateneo de Davao College, in consortium with the Brokenshire Hospital,was to start offering the medical degree in 1977-78.

It was gathered from the interviews that private universities and colleges were reluctant to offer degree programs in the basic sciences as these were expensive to operate and attracted few students. The required laboratory equipment and library facilities for these courses entailed substantial financial outlays which could not be met from tuition fees alone. There was also the problem of recruiting qualified staff and developing them to teach the science courses. The private universities which had established science degree programs received considerable external support for the development of these programs in the form of donations of laboratory equipment and funds for staff development. Officials of the University of San Carlos, Xavier University, Ateneo de Davao College and Central Philippine University revealed that their schools received financial assistance from their respective religious organizations. Through linkages with foreign universities, they were able to assist faculty members in obtaining scholarship grants for advanced studies in the natural sciences or engineering. The University of San Carlos, for example, received grants from agencies in West Germany such as the Central Agency for Development Aid, German Association for Research (Deutsche Forschungsgemeinschaft) and Organization for German Academic Exchange (DAAD). Through DAAD, USC has been able to get West German scientists, especially in marine biology, as visiting professors. Part of the arrangement allows the visiting professors to bring with them scientific equipment needed for their research which is not available at USC. The USC has, therefore, benefitted from the

program through its acquisition of scientific equipment, technical assistance and staff development.

Science and Engineering Faculty: Conditions and Problems

In general, faculty members of private universities/colleges had heavier teaching loads (18 to 24 hours a week) compared with those in state universities/colleges (12 to 15 hours a week). Among 27 heads of science departments interviewed, 12 (44.4 per cent) had teaching loads of nine hours or less a week, eight (29.6 per cent) had 9 to 12 hours a week, while the remaining nine were evenly distributed among those who had teaching loads of 12-15 hours/week, 15-18 hours/week and 18-24 hours/week. Of the 27 department heads, 17 (63 per cent) said that they had laboratory assistants in their science courses who were either graduate students or junior instructors in their department. These were in four state-owned schools: U.P. at Diliman, U.P. at Los Baños, Isabela State College of Agriculture and Central Luzon State University; and two private schools: University of San Carlos and Xavier University.

Of 37 scientists and engineers interviewed (27 heads of science departments, four deans of agriculture colleges and six deans of engineering colleges), 22 had Ph.D. degrees, 13 had Master of Science degrees and two had Bachelor of Science degrees but were doing their M.S. theses. Among scientists with Ph.D. degrees, 16 obtained the degree from universities in the United States and two each from West Germany, the United Kingdom and the Philippines. One was working at the University of San Carlos, four at Central Luzon State University, one at Ateneo de Davao College, one at Xavier University, five at U.P. in Diliman and ten were at the U.P. at Los Baños. More than one-half, (12 out of the 22) Ph.D. holders were in the biological and agricultural sciences.

The scientists who obtained their Ph.D.s or Master's degrees outside the country were active members of international and local scientific/technical societies. Their ties with international scientific societies were usually established during their graduate study abroad.[18] This was true for all but one of the 15 scientists interviewed at the U.P. in Diliman and at Los Baños, one at the University of San Carlos and three at Central Luzon State University. Scientists at U.P. were active officers of scientific societies at the local and national scenes. Some have served as editors of the publications of these societies. In contrast, although most of the heads of science departments in the regional schools were members of scientific societies, they were often unable to attend national conventions for financial reasons and because of teaching responsibilities.

Heads of science departments at the U.P. in Diliman and at Los Baños were actively engaged in research and had published papers in Philippine and international science journals. This was also true for four Ph.D. holders in the regional universities/colleges. Some heads of science departments in U.P., especially those in the agricultural sciences, frequently served as consultants of national agencies such as the Department of Agriculture, Department of Natural Resources, Bureau of Animal Industry, Bureau of Soils and others. Some serve in the commodity teams of PCARR which determine the priority of research projects that are undertaken in agriculture and natural resources. A number of scientists interviewed had represented

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[18] For a look at how Filipino scientists' work are influenced by their ties with foreign scientific societies and foreign scientists, see Florence E. McCarthy, "Third Cultural Networks of Philippine Physical, Life and Social Scientists," (Ph.D. thesis submitted to Michigan State University, Department of Sociology, 1972).

the Philippines at international scientific conferences. The activities of scientists at the U.P. System put them in the forefront of the development of science in the Philippines. It was not surprising, therefore, that President Marcos in 1976 awarded eight faculty members of the U.P. at Los Baños and five other alumni scientists the Jose Rizal Pro Patria Award, in recognition of their outstanding achievements as agricultural scientists and their contribution to the country's agricultural development.[19]

The survey revealed that compared with the U.P. System, regional universities and colleges had difficulties recruiting highly-qualified scientists as full-time faculty members. For example, in one regional school two of its five heads of science departments interviewed had only Bachelor's degrees (one in chemistry and one in education with a major in English and a minor in physics) as their formal qualifications. The two had attended the regional summer training programs for science teachers sponsored by the National Science Development Board and were enrolled in the Master's program during the summer term. Some department chairmen in the regional universities/colleges said they could not recruit science graduates who had majored in mathematics or physics. Hence, these courses were frequently taught by engineers, some of whom had not yet passed the professional board examinations. The President of Ateneo de Davao College mentioned the problem of recruiting faculty members for their chemistry department. He explained:

> As long as you are willing to take in part-time faculty members, recruitment of highly-qualified persons is not a problem. In our

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[19] "FM Confers Jose Rizal Pro Patria Award to 8 UP at Los Baños Faculty Members," The UPLB Horizon, Vol. lV, No. 9 (September-October 1976), pp. 1-2.

school we have part-time faculty who have Master's or Ph.D. degrees in agriculture, engineering or the natural sciences who are actually employed full-time in government agencies or in private industry in Davao City. The only problem, of course, is that the Department of Education and Culture requires us to hire a certain proportion of our staff on a full-time basis.

The President of Isabela State College of Agriculture revealed:

> We have a hard time recruiting forestry graduates for our college faculty. This is because there is only one private university outside of UPLB (Araneta University) which currently offers a complete program in forestry. We have to compete with the private sector, especially the logging concessionaires, pulp and paper corporations, for the few forestry graduates each year. They offer much higher starting salaries than our school.
>
> Our agricultural engineering department is also precariously undermanned. We lack qualified faculty. We are in competition with the National Irrigation Administration (NIA) next door for qualified agricultural engineers. We nearly lost one of our own faculty members to NIA, but managed to keep him because his wife is also employed by our school. This year I had to offer a starting salary of ₱900 a month (corresponding to the rank of assistant professor in our school) to three new faculty members in agricultural engineering. This is still lower than what NIA can offer. The senior members of the faculty naturally grumbled at this decision. However, I had only two options: to get these people or to close the department if it continued to offer substandard courses.

The above problems were also experienced by the Dean of the College of Engineering at University of San Agustin in Iloilo City. He commented:

> We cannot compete with government or private industry when it comes to recruiting for our engineering faculty. The NIA needs around 300 civil engineers for the infrastructure program of the government. It offers engineering graduates, even those who have not yet taken the professional board examinations, a starting salary of ₱920 a month. The private sector in this region offers a starting salary, on the average, of ₱850 a month plus fringe benefits to their engineering recruits. These recruits can expect to rise much faster in rank than in universities. Here at our school, our starting salary for an instructor is only ₱550 a month with a teaching load of 24 hours a week. We lack teachers so we have to ask the Department of Education and Culture for permission to overload our teachers, to let them teach up to 30 hours a week.

The Vice President for Academic Affairs of Central Philippine University in Iloilo City, and formerly Dean of the College of Engineering, observed:

> Once our faculty members get a Master's degree in engineering, we lose them to industry. I have, therefore, been pushing for the adoption of a Master of Science in Engineering Education program which will be self-serving for schools. We will push them for academic life. We have discussed this idea with representatives of the Educational Development Projects Implementing Task Force at the Department of Education and Culture in connection with our school's participation in the government project to upgrade engineering education.

The Dean of the College of Engineering of University of San Carlos in Cebu City had similar comments regarding faculty recruitment and retention. He explained that they needed six new faculty members at their college. All their recent graduates had been recruited by private industry including the Paper Industries Corporation of the Philippines, Del Monte Corporation and San Miguel Corporation. These firms generally offer a higher starting salary than what the University of San Carlos can afford. He said:

> San Miguel Corporation gives a starting salary of ₱1,000 a month to engineers which increases to ₱2,000 a month once they have undergone company training. Nonoc Mines gives ₱750 a month and free housing to engineering graduates during their probation period. After a year, their salary increases to ₱1,000 a month. Here at the University of San Carlos, our professorial chair holder gets only ₱1,500 a month.
>
> We have difficulty retaining our trained faculty. We sent seven to West Germany for advanced studies financed under the West German government's development aid but only two came back. After serving us for three to five years, they also left us. We sent eight to finish the Master of Science in Engineering in U.P. at Diliman but only one returned. We lost seven to industry. They were under contract to serve us for two years for every year of graduate study that we support. However, the contract is only morally binding and not really enforceable.

The Chairman of the Department of Biological Sciences at the same university revealed that they had lost most of their highly-trained staff. He explained:

> Our staff is dwindling. We have lost four Ph.D. holders: one to the United States, three to other institutions in the Philippines -- one each to SEARCA (Southeast Asian Regional Center for Graduate Study in Agriculture), the Department of Education and Culture and SEAFDEC (Southeast Asian Fisheries Development Commission). We have lost two M.S. holders to the

> U.P. College Cebu. Right now I am the only one with a Ph.D. in the Department. They leave because we can not match the salaries offered to them. For example, SEAFDEC pays them three times as much as we can afford.

The Acting Vice President for Finance at USC corroborated the statements of the Dean of the College of Engineering and the Chairman of the Department of Biological Sciences. He pointed out:

> We are training marine biologists up to the M.S. level but they leave us for private firms. These would offer starting salaries from ₱1,000 to ₱3,000 a month but we can only pay them ₱800 a month. Our highest paid faculty members, the professorial chairholders, only get ₱1,500 a month. We have an arrangement with the West German Government where we get scientists as visiting professors financed by them to spend two to three years with us to train Filipinos. However, once the latter are trained, they leave us. Hence, if the West German Government were to stop the program, our department of biological sciences would collapse.

Xavier University in Mindanao experienced similar problems. The chairman of its Department of Biological Sciences related the loss of two of their graduates they had sent to the University of Hawaii for the Master's degree on East-West Center grants. One was lost to SEAFDEC in Iloilo while the other remained in Hawaii. Two other staff members who obtained advanced studies in the United States (one got an M.S. in Oceanography and the other finished the Ph.D. in Biology) decided to emigrate there. The Dean of the College of Agriculture at the same university mentioned that they lost two faculty members they had sent to study for the M.S. degree, to other institutions in the Philippines. He observed:

> These were individuals who had not been with us for a long time and have not caught on with the spirit here, unlike others who have a sense of mission, so to speak. We have not lost any Ph.D.s yet. We have to make financial arrangements attractive for them. We have four professorial chairs for department chairmen funded locally as well as from outside sources. Initially, we start with ₱25,000 a year and will increase it to ₱30,000 a year. This will be the main source of their salary but they will have other sources of income if they have other grants outside. We are aiming for two more professorial chairs so that we can get those with Ph.D.s in the Department.

The University of Mindanao in Davao City also experienced problems of retaining highly-trained faculty. UM's Vice President for Educational Services mentioned that two faculty members in the College of Engineering (who had obtained scholarships at the Asian Institute of Technology in Bangkok, upon the recommendation of UM, to take up the Master of Science in Engineering), returned but stayed at UM for only two or three years. One went to the United States and the other joined a firm in Manila. The Vice President explained:

> Our salary here is not very competitive with industry. As long as they join other institutions within the country, whether industry, government or educational institutions, we do not consider them as being lost. If they emigrate to other countries, then it is a loss for us and for the country.

Job Opportunities in Sciences and Engineering

My findings about the problems of staff recruitment and retention give some indication of the existing job opportunities for scientists and engineers. More specific questions on job opportunities were also directed to the respondents to get more information on this aspect of the problem. One question asked was: Do you think it is easier to get jobs at the present time in your field of specialization compared with when you had just finished your degree? Of 38 respondents who answered this question, 26 thought it was easier to get jobs at present while seven felt it was about the same as when they finished their undergraduate degrees (which was at least 10 years earlier). Only four felt it was more difficult to get jobs at present and one said he did not know. One who answered that it was more difficult to obtain jobs now had her first degree in pharmacy. As she explained it:

> Pharmacy graduates now often get jobs as salesgirls and do not really use their training, i.e. preparation and dispensing of drugs and medicines. This is because the compounding and packaging of drugs have become largely done by pharmaceutical firms.

> These firms prefer to hire chemists or chemical engineers rather than pharmacy graduates.

Three others who thought it was getting more difficult to get jobs felt that there are more graduates in their fields now and hence the competition is much keener.

Among the 26 who thought that job opportunities for scientists and engineers are much better now, there was a consensus in the reasons given: the expansion of the bureaucracy, that is, enlarged as well as new government agencies which employ scientists and engineers; the growth of industry, for example, corporate farms, food processing, chemical-based industries, textile manufacturing, mining and others; and general economic development.

The respondents were also asked whether they thought there would be more job opportunities in their fields of specialization in the next five years. Of 38 who answered the question, 29 said there would be more job opportunities for scientists and engineers, seven felt it would be the same as at present. Only one said there will be less job opportunities, but did not give a reason. One admitted he did not know. Those who forecast more job opportunities for scientists and engineers pointed to the government's infrastructure programs and increased support of scientific research as calling for employment of more scientists and engineeres. The interviewees revealed that they frequently received requests from both government and private sectors for their graduates. Some of the comments elicited about engineers were:

> There is a shortage of graduates in all branches of engineering. (Dean, College of Engineering, University of San Carlos, Cebu City.)

> We have trouble just filling requests for all branches of engineering. There is now a bigger demand for engineering graduates because of industries. (Vice President for Academic Affairs and former Dean of the College of Engineering, Central Philippine University, Iloilo City.)

> As long as engineers are not choosy, they can get jobs. Most graduates go to Manila. In this region, they are employed by sugar centrals, bottling companies and machine shops. (Dean, College of Engineering, University of San Agustin, Iloilo City.)

> There are now more projects and more need for civil engineers. Right now my school can not even satisfy requests for different branches of engineering. There is a lot more development going on in Mindanao. (Dean, College of Engineering, University of Mindanao, Davao City.)

> Because of increasing industrialization, there are more job opportunities at present for my field of specialization (mechanical engineering). As for the next five years, it is very difficult to assess. (Associate Dean, College of Engineering, University of the Philippines.)

> It is easier to get jobs now because of the manpower needs of our present infrastructure program. It is very obvious that the demand for engineers is great and will remain so for the next five or even ten years. (Dean, College of Engineering, Central Luzon State University.)

Interviewees in the agricultural and biological sciences were similarly optimistic about existing and future job opportunities for graduates in their fields. This can be seen from the following comments:

> It is easier to get jobs now as my field of specialization (plant pathology) is not crowded. There will definitely be more job opportunities for agriculture graduates as they will be needed for research and extension work and also as bank appraisers. (Dean, College of Agriculture, Central Luzon State University.)

> There are more agricultural institutions in the country now. The government's agricultural program, private chemical companies and corporate farms need men of my qualifications. (Chairman, Department of Crop Protection, Central Luzon State University.)

> It is easier to get jobs now. We need good people in research in many disciplines, especially the plant sciences, but we can hardly find people with appropriate qualifications, training and experience. Job prospects in the next five years will be about the same as existing opportunities. The plant sciences are expanding and becoming more specialized. (Director of Research, Central Luzon State University.)

Agricultural scientists at the University of the Philippines at Los Baños were also unanimous in assessing job opportunities for graduates in

their fields, that is, there are more job opportunities now than when they themselves first graduated and that there will be more in the next five years or so. Some of their comments were:

> It is easier to get jobs now and these are better paying jobs, too. Corporations such as San Miguel, Construction Development Corporation of the Philippines, etc., recognize the need to understand soils in order to produce something. They need graduates in the soil sciences, preferably males. They offer a salary of ₱1,500 per month as a starting rate whereas here in the UPLB an Instructor I receives only ₱956 a month. We can not supply enough of the demands of commercial plantations. There will definitely be more job opportunities in the next five years. (Chairman, Department of Soil Science, U.P. at Los Baños.)

> All our graduates get jobs as we get many requests for placement. Our graduates are very selective so that sometimes private companies think they are asking too much. There will definitely be more job opportunities in the next five years because of the expanding livestock and poultry industry in the country. Our graduates are given priority and preferential treatment in all sectors of employment. (Chairman, Department of Animal Science, U.P. at Los Baños.)

> It is easier to get jobs now as there is greater demand for entomologists from both the government and private sector. There will definitely be more job opportunities for agriculture graduates, especially entomology majors, because of the trend towards increased crop protection. (Chairman, Department of Entomology, U.P. at Los Baños.)

> It is easier to get jobs now in zoology. Graduates can go to government agencies such as the Bureau of Fisheries, Parks and Wildlife, the National Museum, etc. or work in the private sector as well as teach in high schools or colleges. There will definitely be more job opportunities in the future because there are technical fields which were not developed before that would now need zoologists such as, for example, medical research, cancer research, heart research, etc. These areas have now advanced to a certain level. (Chairman, Department of Zoology, U.P. at Los Baños.)

Similar comments were obtained from interviewees in other schools. For example:

> Agriculture is given priority support by the government. We cannot cope with requests for our graduates. Last year, the Provincial Agriculturist for Davao sent a request for 50 of our new graduates but we could not meet it. (Dean, College of Agriculture, Central Philippine University, Iloilo City.)

Each year we get requests for some 200 graduates from both the government and private sectors. We follow up a good bit for placement work. We cannot meet these requests. In March 1977, we had only 47 graduates. We will have 60 graduates in October 1977. We hope to graduate 80 to 100 in the next year. The major aim of our college's program is to get people back in agricultural production. About 60 per cent of our graduates work in family lands, the rest are in managerial position including government. The number of our graduates joining government has increased in the last few years. (Dean, College of Agriculture, Xavier University, Cagayan de Oro City.)

Assessments of job opportunities among physical scientists were also optimistic. Some of their comments were:

Our graduates then and now are in demand. All of them have found employment. There will be more job opportunities for chemists as we are now more conscious of the necessity for research in science and technology. (Chairman, Department of Chemistry, University of the Philippines, Quezon City.)

There will definitely be more job opportunities especially in applied mathematics. The trend is in making use of computers. Business firms will have more need for these graduates including statistics, but not much for physics majors. (Chairman, Department of Mathematics, Statistics and Physics, U.P. at Los Baños.)

It is easier to get jobs at the present time. Because of increased student enrollment in the sciences, there are more teaching opportunities. The increase in the volume of business in chemical-based companies also means increasing employment opportunities. Within the next five years, employment opportunities will be about the same as those existing. (Chairman, Department of Chemistry, U.P. at Los Baños.)

It is easier to get jobs now. You can hardly find any chemist who is jobless. There will definitely be more job opportunities because of our increasing industrialization. (Coordinator for Research, Sugar Technology Program, U.P. at Los Baños.)

It is easier to get jobs now. There are very few who go into physics, hence,there is not much competition in this field. There will definitely be more job opportunities for physics majors as very few still go into this field. (Vice Chairman, Department of Mathematics and Physics, Isabela State College of Agriculture.)

Relevance and Adequacy of Education and Training of Scientists and Engineers

The opinions of the interviewees on job opportunities for science and engineering graduates suggest that the problem of underemployment and unemployment of scientists and engineers may be temporary and largely due to their regional maldistribution, that is, to the fact that they tended to concentrate in the more urbanized regions, especially in the Metropolitan Manila Area. At the beginning of this study, it was suggested that there was a regional maldistribution, and a problem of mismatch between education and training and the actual social needs and conditions of the Philippines. Considerable attention was devoted to this aspect of the problem in the interviews.

One question asked was: Do you think that the existing curriculum or training in your field of specialization is suited to social needs and conditions in the Philippines at present? They were asked to explain their answers. Of 33 who responded (27 department chairmen and six deans of agriculture or engineering), 29 believed that the curriculum and training in their fields of specialization is suited to the social needs and conditions in the country, three answered "no" and one said he did not know. Two interviewees who believed that the education and training of scientists and engineers is not suited to the Philippines commented:

> The curriculum and training (in chemistry) provides the basic principles of science but the direct connection between these and our social needs and conditions is not brought out even in the course of instruction.

> The existing curriculum (in biology) needs updating to meet present needs.

Among those who felt that the curriculum and training in their fields of specialization was suited to Philippine needs and conditions, there

was a consensus that scientific principles and theories are valid everywhere. It is in their application that theories can be adapted to focus on or emphasize particular conditions or specific needs. They explained that this was what they have been doing in their teaching of science and engineering subjects. Some comments were:

> We revised the engineering curricula in 1974-75 by working with engineering societies and representatives of the Department of Education and Culture. (Dean, College of Engineering, University of San Carlos.)

> The engineering curricula evolved, in 1974-75, jointly by Deans of engineering colleges, representatives of engineering societies and the Department of Education and Culture, was designed for the needs of industry and government. (Dean, College of Engineering, University of Mindanao.)

> Our engineering program is suited to our social needs and conditions because we constantly adapt our curriculum to feedback from our alumni and our practice. There are formal surveys conducted by our departments. One professional society I know which is active in curriculum development is the Philippine Institute of Chemical Engineers. (Associate Dean, College of Engineering, University of the Philippines.)

> The chemistry curriculum here is flexible enough to enable a student to choose courses to fit his plans -- whether he wants to go to graduate work and teaching/research or if he wants to work in industry. (Chairman, Department of Chemistry, University of the Philippines, Quezon City.)

> If by social needs we mean grassroots or backyard production, our graduates (in animal science) are more suited to large-scale production. However, they can also serve as extension men to serve the grassroots. They are equally prepared to serve government or the private sector. (Chairman, Department of Animal Science, U.P. at Los Baños.)

> Our present curriculum in fisheries is attuned to the needs of Central Luzon region which is the service area of the university. (Chairman, Department of Aquatic Biology and Dean, College of Inland Fisheries, Central Luzon State University.)

> We have adjusted our curriculum and also keep in contact with U.P. at Los Baños on curriculum development. We now stress ecology, nature studies, marine biology, pollution problems and entomology. (Chairman, Department of Biology, University of San Carlos.)

> Our curriculum is relevant but it needs constant revision because we have been too Western-oriented in thinking. For example, regarding the use of chemicals which we import from foreign countries, we have to change this because our farmers cannot afford many of these. (Chairman, Department of Entomology, U.P. at Los Baños.)

> To suit the curriculum in agriculture to Philippine needs and conditions, we have emphasized the economic side of production. We have found out that farmers pay little attention to the economic side of agriculture. We require every student to take at least four subjects in basic agricultural economics. We emphasize actual field work. For every two lectures in a professional subject each week, we require three hours work a week in the field and thirty per cent of their grades will be on their performance in the field work. We try to show that being in agriculture is not an easy life, physically, including vagaries in weather. They have to love the land by working in it or quit and save us the time and money. Private corporations have found that our graduates are not afraid to work. We emphasize problem-oriented rather than basic research in our courses. (Dean, College of Agriculture, Xavier University.)

A corollary question posed to the interviewees was: Do you think the textbooks/reference books in your courses are suited to the existing social needs and conditions in the Philippines? Of 31 who answered this question, 22 said "yes" and nine answered "no". All 31 respondents, nevertheless, pointed out that most of the textbooks they used are foreign. They differed in their opinion in that the 22 who answered "yes" stressed the universality of scientific principles and theories; and their task was to direct the application of theories to local conditions and problems. Those who answered in the negative emphasized that because most of the science books were written by foreign authors, the examples used were irrelevant to the Philippine situation or do not jibe with local conditions. Sample comments were:

> Scientific theories and principles are more or less uniform. It does not really matter whether they are written by Filipinos or not. For example, in one of our courses in Animal Science, there is no textbook. We use the product of our research. The course is taught by a team of four staff members who specialize

in poultry, dairy, swine, etc. The faculty are also well aware of industry in the country. They ensure that the materials used in our courses would always take into consideration the conditions in the Philippines. (Chairman, Department of Animal Science, U.P. at Los Baños.)

We use both foreign and local textbooks. We design our laboratory exercises to suit them to local conditions. (Chairman, Department of Biological Sciences, Isabela State College of Agriculture.)

We use foreign textbooks but usually adjust them with Philippine materials from U.P. and NSDB. (Chairman, Department of Biological Sciences, University of San Carlos.)

In biology, I made a laboratory manual suited to local conditions and included conservation. We do not use imported manuals. We biology teachers get together and prepare our own manuals. We change these every now and then. Our textbooks are foreign but we select chapters, modifying them to suit our conditions, when we make the course syllabus. (Chairman, Department of Biological Sciences, Xavier University.)

The science textbooks that we use are intended for age brackets two years older than our freshmen students. The technical language may be too heavy for them. The practice of our lecturers is to get some materials from Filipino textbooks. (Chairman, Department of Chemistry, U.P. at Los Baños.)

All 31 respondents were in agreement that it was high time for more Filipino scientists and engineers to write science textbooks that would focus on Philippine conditions, needs and problems.

One question asked of the respondents who had obtained their advanced degrees in foreign countries, which had a bearing on the question of adequacy of the training of Filipino scientists and engineers was: How would you rate the initial education and training obtained in the Philippines in your field of study compared with the same level of training obtainable in the U.S.A. (or country where you trained)? Of the 23 interviewees who answered the question, two said that their Philippine training was superior. The two finished their undergraduate degrees (one in botany and the other in plant pathology) from the U.P. at Diliman and at

Los Baños, respectively. Eleven considered their undergraduate training in the Philippines as more or less equal with that obtainable in the United States. Eight said that their Philippine training was weaker in some respects. Five of these mentioned the lack of exposure to equipment or inadequate laboratory facilities and three specified their weak preparation in the basic sciences such as chemistry, mathematics and physics. Only one considered his Philippine training as inferior and explained:

> I majored in organic chemistry at U.P. but I still had to take deficiency undergraduate courses when I did my Ph.D. in chemistry in the United States.

My interviewees believed that the education and training of scientists and engineers in the Philippines had improved a lot since their undergraduate days. They felt that it was now possible to obtain advanced training in certain fields of science and engineering in the country. When asked to which schools in the Philippines they would advice their best students or junior faculty to go for the M.S. or Ph.D., all mentioned the U.P. in Diliman for such fields as the physical and biological sciences and engineering, the U.P. at Los Baños for the biological and agricultural sciences and the Ateneo de Manila University for mathematics and chemistry. Other schools mentioned were the University of San Carlos and University of Santo Tomas for the M.S. in the biological and physical sciences.

Views on the Brain Drain

One question asked in this research was the extent of the brain drain of scientists and engineers from the Philippines and how far this was really a problem. In the course of the interviews, instances of the brain drain were mentioned in connection with the recruitment and retention of qualified faculty. The interviewees were also asked whether they considered the

brain drain as a problem in their fields of specialization.

Of 34 who responded, 13 said it was definitely a problem while 21 thought that it was not really a problem. Those who considered the brain drain as definitely a problem were specialists in physics, chemistry, mathematics and biology. The brain drain, they felt, leads to a depletion of highly-trained people who should be in the faculty of colleges and universities. The experiences of the College of Engineering and Department of Biological Sciences of the University of San Carlos and the Department of Biological Sciences of Xavier University have already been cited. Moreover, the Chairman of the Department of Chemistry at the U.P. in Diliman revealed that about 50 per cent of the undergraduate class to which she belonged (1963) were already immigrants in the United States. She pointed out that she was the only one left of six Ph.D.s in chemistry who returned to U.P. since 1969. Two department chairmen in the U.P. at Los Baños also mentioned four Ph.D.s who joined the brain drain -- one in biochemistry, two in physics and one in animal science. Three of the individuals mentioned had obtained their Ph.D.s through the U.P. faculty development program while the fourth had been brought back into the country through NSDB's Balik-Scientist Program.[20] These cases of the brain drain represented a loss of much needed manpower as well as government funds invested in their training and travel.

Six interviewees who thought that the brain drain is not really a problem were in engineering. They believed that the Philippines was not

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[20]Details of the Program are discussed in Chapter IX, pp. 452-455.

really losing its highly-trained engineers as most of those who leave were B.S. graduates who could not find employment within the country. They contended that the new engineers who go abroad gain valuable experience in their work and many also take advanced studies while working abroad. The interviewees argued that the country will benefit in the long run from the engineers who work abroad as they will come back with valuable experience and training. Moreover, they pointed out that these emigrant engineers, doctors and nurses remit their earnings abroad to families and relatives who are left behind in the country.

Other respondents who believed that the brain drain is not much of a problem were in agricultural sciences, forestry and fisheries. According to these interviewees, the Philippines is not losing its highly-trained manpower in these fields as there are many available jobs in government, schools and the private sector. Research, it was claimed, is also receiving much challenge and financial support in these areas.

The interviewees were asked what they thought were the reasons why highly-trained scientists and engineers leave the country. The foremost reason given by 31 respondents was economic, i.e. to have better employment opportunities. A second reason mentioned (by 17 respondents) was "to get further education and training." One respondent gave as reason "the scientist could not find the facilities he needed in the Philippines" to explain the brain drain.

Were the interviewees aware of any government policy to try to bring home Filipino scientists and engineers abroad? To this question, 29 said they were aware of such policy while eight said they were unaware. Of those who were aware, 20 mentioned the Balik-Scientist Program (BSP). Only seven of those who said they were aware of government policy to bring

home scientists and engineers abroad felt that such policy would be effective. Eighteen believed that the policy would be ineffective while the rest gave no comments. Of the 20 who mentioned being aware of the BSP, 15 were from the U.P. System and five were from the regions. Of those in the regions, two could not identify which government agency was in charge of the program. Some comments on the BSP were:

> If these scientists really want to serve the country, there is no need for empty or glorious promises.

> The BSP participants are not really all that good. Some only take advantage of the program. The alternative policy perhaps, in order to attract the best scientists, engineers or medical personnel is to set aside a foundation to invite them for a year as visiting professors rather than spread the red carpet around.

> The BSP program is not really the answer. Some people are taking advantage of NSDB funds for the program to go around the Philippines and visit their families.

> Personally, I will not convince scientists and engineers to come home. In the first place, they went away on their own. They should come home voluntarily. It would be unfair to those who stayed at home. We are pampering those from abroad when they come home. They keep complaining about the facilities and salaries here. I would rather give support to those who have remained in the country and who are as good.

A question that sheds more light into the brain drain is why scientists who studied abroad voluntarily returned to the country after completing their degrees. This was posed to the 20 respondents who had obtained their Ph.D.s abroad. Twelve said that they returned because they were under contract with the government. Eight mentioned the fact that their families were left behind. Three felt they would have more recognition for their work in the Philippines than if they remained abroad. Other reasons given were:

> I had really no intention of staying there. (U.S.A.)

> I came home to serve my country and my people.

I was training myself to prepare me better to do my job here.

The country deserves my training more than others. I am happier and more satisfied here.

I wanted to see how I can work things out in the country.

As can be seen from the comments, patriotism or nationalism is a strong motivation for scientists to return and work in the Philippines. Moreover, those who were under contract with their schools or sponsoring institutions and whose families were left behind had a stronger motivation to return home.

Views on Policies to Bring Home Scientists and Engineers

A set of six proposed policies to bring home Filipino scientists, engineers and medical personnel were presented to the interviewees for their assessment, i.e. whether they thought these would contribute greatly, somewhat or not at all to the achievement of this goal. Thirty-three respondents thought that the policy to "increase or upgrade salaries of scientists, engineers and medical personnel in various government agencies and offices" would contribute greatly to bring home highly-trained manpower. Thirty-two interviewees considered the "creation of more facilities for the high training of science and engineering manpower within the country" and the "increase in government spending for research" would contribute greatly to bring home these qualified people. Thirty-one respondents considered the "reorganization of government science agencies to eliminate bureaucratic red tape in the conduct of scientific research" would contribute greatly to bring home highly trained scientists and engineers. Peace and order condition was not considered as a problem by the respondents and, hence, they rated policies directed towards the improvement of this issue as not contributing to the achievement of bringing

home emigrant scientists and engineers.

The respondents were also presented with a set of proposed government policies designed to stop the emigration of scientists and engineers to other countries. Of the four hypothetical policies presented, 37 respondents chose: "The government should create more jobs for science graduates by increasing government spending for scientific research and development for industry as well as for agriculture." They approved of this policy and felt that it would be very effective. The policy to "regulate the enrollment of students in the colleges and universities to match the number of available jobs in the public and private sectors as shown by the yearly economic forecast" was approved by 24 respondents. Nevertheless, they pointed out that this policy was possible only in theory as there was no realistic means of forecasting the type and number of jobs that would be available annually. The proposed policy "to require all new graduates in science and engineering to serve a period of time in the rural areas before they can be given passports or exit visas" was endorsed by 29 respondents. However, only thirteen thought that this would be effective in stopping scientists and engineers from leaving the country. Some scientists pointed out that rural service was not possible for all science graduates as there would be some, like chemists and physicists, who would find no jobs in rural areas.

Summary and Conclusion

The data in Chapter II, as supported by findings of this survey of scientists and engineers in educational institutions, show that there is a regional maldistribution of trained scientists and engineers in the country. This undoubtedly causes their underemployment and unemployment in some areas, especially in urban places, and their shortage in other

regions. The regional maldistribution of scientists and engineers seems to be closely related to the concentration of universities and colleges, industry and government agencies in the Metropolitan Manila Area (MMA). Thus MMA attracts the best students in the country and also the highly-qualified scientists and engineers. The shortage of scientists and engineers in the regions surveyed suggests that the country has reached a certain level of economic development which needs the services of these qualified manpower.

The results of my interviews indicate that while there may be an excess of graduates in certain fields such as engineering, nursing and medicine, there is a shortage in others, like physics, mathematics, chemistry, the biological sciences, forestry, and the like. Thus there is a keen competition between government, industry and universities for the few graduates in these fields. This is especially true for those with advanced training, i.e. M.S. or Ph.D. holders. As compensation levels are relatively low in universities, particularly in private schools, there is a tendency for highly-trained scientists and engineers to move out of universities and transfer to industry or government. This has obvious implications for the improvement and maintenance of quality education in the sciences and engineering within the country.

The brain drain, or emigration of highly qualified scientists and engineers, has affected some universities surveyed in this study. It appears that institutions which have staff development programs (U.P., USC and Xavier University) to establish strong science and engineering departments have been the ones adversely affected by the loss of highly-trained manpower.

Certain policy recommendations can be derived from these findings. One is that the government should provide incentives or directly assist

universsities in the regions, both public and private, to strengthen their science and engineering programs in order to deconcentrate student enrollments in the universities in Metropolitan Manila. The grant of state scholarships could be tied up with this goal, that is, recipients should be required to enroll in the university/college nearest their hometown, depending on the fields of study that they intend to pursue. These grants should be accompanied by contracts with the government, which must stipulate that the student agrees to serve in whatever region he may later be assigned for at least the same length of time that he enjoyed the scholarship award. The government should also strengthen its regional employment centers in order to systematize the monitoring of information on supply and demand of scientists and engineers all over the country. Such information would greatly aid universities and colleges in planning their programs and in counselling students and graduates regarding job prospects.

In the next chapter, I shall examine the perceptions of working professionals, particularly emigrant Filipino medical scientists and physicians in the United States and participants of NSDB's Balik-Scientist Program, on science policy and the education and training of scientists and engineers.

Chapter IX

Science Policy and the Education of Scientists and Engineers: Perceptions of Professionals

This chapter will focus on the views of the professionals about the adequacy of their education and training and its relevance to Philippine needs, their employment prospects and opportunities for advancement, and government policies affecting these areas of concern. For this purpose, data were gathered on two groups of professionals -- Filipino medical scientists and physicians who have emigrated to the United States and returning scientists and engineers under NSDB's Balik-Scientist Program. This was done by a combination of mailed questionnaires and interviews.

The choice as respondents of medical scientists and physicians was prompted by the increasing attention that has been given to the loss of large numbers of these professionals especially to the United States and Canada. Statistics have shown that this group comprises the largest number of highly trained persons lost to the country. At the end of 1969, some 9,320 (39.8 per cent of the total number) Philippine trained physicians were out of the country. Majority (5,720) were considered permanently lost to the United States as immigrants; 3,600 were temporarily out of the country, most of them on the Exchange Visitors Program with the United States.[1] At the same time, there were continuing complaints that most of the rural population (which made up more than 70 per cent of the nation's total) was without proper medical attention. The

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[1] 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, 4-10 October 1970, Table IV, p. 7.

Philippines was reported to have one of the highest death rates from tuberculosis in Asia -- 80 deaths per 100,000 population compared to less than 40 for Hongkong and less than 30 for Singapore.[2]

By 1975, the number of Filipino physicians in the United States had reached 7,352.[3] Considering that these represented the upper 50 per cent of Philippine medical graduates (as evidenced by their success in passing the examinations administered by the U.S. Educational Council for Foreign Medical Graduates), their loss is bound to have adverse effects on the adequacy of health care and medical education in the Philippines. As the Dean of a medical college put it:

> This definitely depletes the country of its better prepared MDs in general and the teaching hospitals of the ... medical schools, in particular, of good material for its own residency program which in turn decidedly affects in a negative way the medical schools' undergraduate program. It further deprives the basic medical science departments of good recruits to fill the ranks of its staff. A situation thus exists wherein all efforts exerted by Philippine medical schools to improve become negated, as far as quality of medical education based on Western standard is concerned.[4]

The continuing medical brain drain, and the inadequate health and medical care in the Philippines have aroused concern among government

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[2]Bernard Wideman, "Health Care in Need of a Tonic," Far Eastern Economic Review, Vol. 86, No. 47 (29 November 1974), pp. 24-25.

[3]Stephen S. Mick, "The Foreign Medical Graduate," Scientific American, Vol. 232, No. 2 (February 1975), p. 17. The 1974 Philippine Physicians Directory of the U.S.A. listed 8,265 Filipino doctors. The list included permanent immigrants and those undergoing residency training under the Exchange Visitors Program. Inclusion in the directory was solicited, and,therefore, on a voluntary basis, according to some immigrant physicians interviewed by the writer. Hence, it is possible that there are more physicians in the United States than is listed in the Directory.

[4]Cuyegkeng, op. cit., p. 10.

policymakers and medical educators. As shown in Chapter IV, medical educators and practising members of the profession have been discussing the need for making medical education relevant to Philippine needs and conditions while at the same time maintaining acceptable standards in the profession, the need to remedy the maldistribution of physicians and to ensure their adequate employment.[5] The medical brain drain has been attributed to two related factors: (1) the desire of MDs for further training after licensure which is not available in the Philippines and (2) lack of opportunities for professional satisfaction upon their return to the country.[6] Given the government pronouncements on the need to review its science policies and to attract home emigrant scientists, it was thought worthwhile to find out the perceptions of emigrant medical scientists and physicians themselves about these issues. These views may suggest some policy options for Philippine medical educators and government decision makers. Consequently, questionnaires were mailed to a sample of medical scientists and physicians in the United States.

A. Survey of Emigrant Filipino Medical Scientists and Physicians

The 10-page survey questionnaire was sent to 196 Filipino physicians and 219 medical scientists, that is, MDs who had teaching or research appointments in medical schools, teaching hospitals or research laboratories in the United States. Their names were drawn at random from the 1974 Philippine Physicians Directory of the U.S.A.. This list comprised 8,265 MDs. Of this number, 438 had indicated their present position

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[5] See, for example, 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), pp. 72-100.

[6] Cuyegkeng, op. cit., pp. 9, 13-14, 17-18.

as faculty members or researchers in medical schools, teaching hospitals and laboratories. The remaining 7,827 indicated that they were private practitioners, hospital staff employees or employed by public health departments. Half of the MDs in the first group (219) were sent questionnaires. Every 40th name of those in the second group were included in the sample, totaling 196.[7] Of the 415 questionnaires sent out, 98 were duly accomplished and returned, 59 from practising physicians and 39 from medical scientists.[8]

Of particular interest for this study were questions on the educational background and training of the respondents; their reasons for leaving the Philippines; how useful they found the training they obtained in the Philippines; their awareness of, and views about, government policies designed to stem the continuing emigration of scientists, engineers and physicians; and policies designed to attract them home.

Of the 95 medical scientists and physicians in the survey who reported their sex, 71 (74.7 per cent) were males and 24 (25.3 per cent) were females. Over half were 31 to 40 years old -- 63.4 per cent of the males and 66.7 per cent of the females. The respondents were scattered in 25 of the 50 states. The largest group, 23.7 per cent, were working in New York state. Maryland had 9.3 per cent; Pennsylvania and

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[7] The questionnaires were mailed (with self-addressed return envelopes) from Queen's University in Kingston, Canada in April 1975. A follow-up letter and questionnaire was sent in July 1975.

[8] One respondent turned out to be an American who had gone to the Philippines purposely to study medicine. In the final tabulations, his responses were excluded but will be footnoted whenever relevant. Thirty questionnaires came back unanswered because the addressees had moved without leaving any forwarding address (two had been deceased). One respondent returned the questionnaire unanswered because he had been away from the Philippines "too long to know what is going on" and another did so for "fear of Martial Law."

Illinois had 8.2 per cent each; Ohio and Missouri had 6.2 per cent each; while Michigan and New Jersey had 5.2 per cent each of the total number of respondents. Together these states accounted for 72.2 per cent of the respondents. The rest were in California (4.1 per cent), Wisconsin (3.1 per cent), 2 per cent each in Kansas, Iowa, Kentucky, Massachusetts, Texas and 1 respondent each in Alabama, Arizona, Delaware, Florida, Hawaii, Louisiana, Nebraska, North Carolina, Virginia and West Virginia.[9]

In terms of work or position held at the time of the survey, 39 respondents (40.2 per cent) had teaching and/or research appointments in medical colleges, teaching hospitals and laboratories. Fifty-eight (59.8 per cent) were engaged mainly in medical practice -- 30 as hospital staff, 21 in private practice, 4 in public health programs and 3 were undergoing residency training programs.[10] Two of the latter were under the Exchange Visitors Program.

Socioeconomic Backgrounds

The majority of the Filipino MDs in the survey were born in Region IV which includes Metropolitan Manila Area and the Southern Tagalog provinces. Of 41 (42.3 per cent) respondents from this region, 31 (32 per cent) were actually natives of the city of Manila and its suburbs. Regardless of their region of birth, 71 (73.2 per cent) reported Metropolitan Manila Area and the Southern Tagalog provinces as their last place of residence before going to the United States. Forty-six (47.4

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[9]This geographical distribution roughly reflects the concentration of foreign medical graduates (FMGs) in the United States. Available statistics show that 60.9 per cent of FMGs are found in the New England, Mid-Atlantic and South Atlantic States and 23 per cent are in the East North Central and East South Central States. See Mick, op. cit., pp. 20-21.

[10]This excludes the American respondent who is engaged in private medical practice.

Table IX-1
Place of Birth and Last Place of Residence
of Immigrant Filipino Physicians and Medical Scientists in U.S.A.

Region of Birth	Region of Last Residence[a]										
	I	III	IV	V	VI	VII	X	XI	Did Not Report	Total
I. Ilocos	3	-	5	-	1	-	-	-	-	9
II. Cagayan Valley	-	-	4	-	-	-	-	-	-	4
III. Central Luzon	-	4	6	-	-	-	-	-	-	10
IV. Southern Tagalog	-	-	38[b]	1	-	-	-	1	1	41
V. Bicol	-	-	3	1	-	-	-	-	-	4
VI. Western Visayas	-	-	2	-	4	-	-	-	-	6
VII. Central Visayas	-	-	-	-	1	-	-	-	-	1
VIII. Eastern Visayas	-	-	1	-	-	1	-	-	1	3
IX. Southwestern Mindanao	-	-	-	-	-	-	-	1	-	1
X. Northeastern Mindanao	-	-	1	-	-	-	1	-	-	2
XI. Southern Mindanao	-	-	-	-	-	-	-	-	-	-
Did Not Report	1	1	11	1	-	1	-	-	1	16
Total	4	5	71[c]	3	6	2	1	2	3	97

[a]There were no respondents who reported residing in Regions II, VIII and IX.

[b]Thirty-one respondents were born in the Metropolitan Manila Area.

[c]Forty-six respondents resided in the Metropolitan Manila area.

per cent) were actually residing before departure in the Metropolitan Manila Area. Table IX-1 shows the place of birth and last place of residence of the respondents.

Over half of the respondents had professional fathers -- physicians, lawyers, dentists, engineers, and the like. Fourteen (15.1 per cent) reported that their fathers were physicians. Thirty-seven had mothers who were professionals; two (2.1 per cent) indicated their mothers were MDs. Twelve said their fathers were government employees. Six of these had mothers who were government employees. One indicated his father was

a laborer; seven reported their fathers were either farmers, fishermen or carpenters. Table IX-2 gives details on parents' occupations.

Table IX-2
Occupation of Parents of Immigrant
Filipino Physicians and Medical Scientists in U.S.A.

Occupation	Father		Mother	
	Number	Per Cent	Number	Per Cent
Laborer	1	1.1	-	-
Farmer, Fisherman, Carpenter	7	7.5	1	1.1
Small Business Proprietor	5	5.4	8	8.5
Businessman	9	9.7	4	4.2
Employed in Private Sector	3	3.2	1	1.1
Government Employee	12	12.9	6	6.3
Professional -- Lawyer, Physician, etc.	53	57.0	37	39.4
Housewife	-	-	37	39.4
Others	3	3.2	-	-
Total	93[a]	100.0	94[b]	100.0

[a]Four respondents did not give their father's occupation.

[b]Three respondents did not state their mother's occupation.

Sixty-two (66.7 per cent) said their fathers had at least a Bachelor's degree. Of this number, 46 (48.9 per cent) reported their mothers finished the Bachelor's degree. Twenty (21.5 per cent) respondents indicated their fathers completed secondary school with seven of them having some vocational/technical courses. Twenty-four (27.3 per cent) had mothers who finished their secondary education; two of them had some vocational/technical schooling. A minority had parents with only elementary education -- 11 fathers and 17 mothers. Table IX-3 provides more information on the highest educational attainment of respondents' parents.

Preference for the medical profession tended to run in the families of the respondents. Fifty-seven (58.8 per cent) indicated they had relatives who were also physicians. Of this number, 25 (43.9 per cent)

Table IX-3
Highest Educational Attainment of Parents of Immigrant Filipino Physicians and Medical Scientists in U.S.A.

Highest Educational Attainment	Father		Mother	
	Number	Per Cent	Number	Per Cent
Elementary School	11	11.8	17	19.3
Secondary School	13	14.0	22	25.0
Vocational/Technical School	7	7.5	2	2.3
Bachelor's Degree	52	55.9	41	46.6
Master's, Ph.D., M.D.	10	10.8	5	5.7
Others	-	-	1	1.1
Total	93[a]	100.0	88[b]	100.0

[a]Four respondents did not indicate their father's educational attainment.

[b]Nine respondents did not specify their mother's educational attainment.

revealed that at least one other member of the family -- father, mother, brother or sister -- belonged to the medical profession. The rest had either uncles, aunts, cousins or grandparents who were physicians. Of the 57 with relatives who were MDs, 31 (54.4 per cent) had more than one relative in the medical profession. Seven (7.2 per cent) who had no MD relatives had at least one parent in allied professions like nursing, pharmacy or dentistry.

In terms of their basic medical education, 34 (35.1 per cent) were graduates of the University of Santo Tomas, 31 (32 per cent) were from the University of the Philippines, and the rest were from other medical colleges. Table IX-4 gives more information.

The data suggest the extent of the loss to the country in terms of public investment. While the share of the UP College of Medicine in the annual output of medical graduates in the Philippines is only about 15 per cent, slightly less than a third of the immigrants sampled were

Table IX-4
Medical School Attended and Present Work of Immigrant Filipino Physicians and Medical Scientists in U.S.A.

Medical School Attended in the Philippines	Present Work in U.S.A.					
	Academic, Teaching, Research	Exchange Visitors Residency	Hospital Staff	Private Practice	Public Health Clinic	Total
Cebu Institute of Technology	-	-	1	-	-	1
Far Eastern University	3	-	6	3	-	12
Manila Central University	-	1	3	3	1	8
University of the East	5	-	5	1	-	11
University of the Philippines	15	2	7	7	-	31
University of Santo Tomas	16	-	8	8	2	34
Total	39	3	30	22	3	97*
Per Cent	40.2	3.1	30.9	22.7	3.1	100.0

*A 98th respondent, a native American, studied in Manila's Far Eastern University College of Medicine and is now in private practice in Pennsylvania. Data on this respondent were not included in the other table analyses.

from this school. Medical students at UP pay for their own tuition and other fees as in other schools but are actually heavily subsidized by the government. Tuition fees at UP are much lower than those in the private medical colleges. Moreover, because enrollment is kept at a low level at the UP College of Medicine, about one hundred freshmen students a year, admission requirements are high, and more adequate instructional facilities and low faculty/student ratios are possible. Quality education is assured there at a comparatively lower cost in terms of student fees. The emigration of UP medical graduates means not only the loss of monetary investment but also the loss of the cream of medical graduates.

The 39 MDs employed in teaching or research positions represented different fields of specialization like pediatrics, radiology, rehabi-

litation medicine, surgery, anaesthesiology, internal medicine, opthalmology, neuropathology, obstetrics-gynecology, pathology, neurosurgery cardiology, serology and genetics, psychiatry, immunology and others. Judging from their positions in the United States at the time of the survey, it may be inferred that they would indeed be needed to staff medical schools, teaching hospitals and research establishments in the Philippines.

Half of the respondents were immigrants or permanent residents in the United States. The rest were already U.S. citizens, holders of working visas or on the Exchange Visitors Program. Most had been in the United States for over five years. Thirty-one (32 per cent) had been there for six to nine years; 35 (36.1 per cent) had been residents for 10 to 14 years; and 20 (20.6 per cent) had been staying there for more than 15 years. Table IX-5 shows the respondents' length of stay in the United States and their visa status.

Table IX-5
Length of Stay and Visa Status of Immigrant Filipino Physicians and Medical Scientists in U.S.A.

No. of Years Stay in U.S.A.	Visa Status					
	Exchange Visitor	Working Visa	Immigrant, Permanent Resident	U.S. Citizen	Not Stated	Total
2-5 years	2	1	6	2	-	11
6-9	1	-	24	6	-	31
10-14	-	1	16	17	1	35
15-19	-	-	2	8	-	10
20 and above	-	-	1	9	-	10
Total	3	2	49	42	1	97
Per Cent	3.1	2.1	50.5	43.3	1	100.0

Asked how closely they followed events and developments in the Philippines, 21 (21.6 per cent) said they subscribed to Philippine newspaper and magazines; 64 (66 per cent) said they did not follow events closely, their main source of information being letters from relatives and friends and what they occasionally read from Philippine periodicals, U.S. and Canadian papers; and eight (8.2 per cent) said they relied mainly on U.S. and Canadian papers. Only one respondent said he was no longer interested in what was going on in the Philippines; he had lived in the United States for over 10 years.

Reasons for Leaving the Philippines

What were the reasons why these scientists and physicians left the Philippines? Asked to rank a number of reasons for leaving, 85 (87.6 per cent) indicated "to get further education and training" as the principal reason. For 19 (19.6 per cent) respondents,this was, in fact, the only reason why they left the country. Dissatisfaction with their work in the Philippines was given as the most important by seven (7.2 per cent) while 11 (11.3 per cent) gave this as the second most important reason. Related to this reason was "to have better employment opportunities." One respondent gave this as the most important reason for leaving the country while 27 (27.8 per cent) mentioned this as their second most important reason. Table IX-6 gives further details.

As can be inferred from the data, the desire for further education and training and job related reasons are two of the most important "push" factors which have engendered the "brain drain." Medical educators have admitted that there are very few places for residency and specialty training in the Philippines.[11] Hence, many medical graduates

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[11] Cuyegkeng, loc. cit.

Table IX-6
Reasons for Leaving the Philippines Given by
Immigrant Filipino Physicians and Medical Scientists in U.S.A.*

Reasons for Leaving the Philippines	Ranking of Reasons in Order of Importance							
	1st	2nd	3rd	4th	5th	6th	7th	Total
To get further education and training	85	3	2	-	-	-	-	90
Dissatisfied over work in the Philippines	7	11	6	2	3	7	3	39
Travel and adventure	1	28	12	6	3	1	1	52
Peace and order	3	-	1	6	4	5	7	26
To have better employment opportunities	1	27	18	5	2	1	-	54
Influence of friends and colleagues	-	3	12	9	8	3	1	36
Influence of family and relatives	-	3	4	8	8	5	3	31

*The question allowed for multiple answers;hence, the discrepancy between the number of respondents and responses.

must look for such opportunities elsewhere. Moreover, compensation for residency training in the Philippines is considered far from satisfactory. This is confirmed by responses to an open-ended question on the reasons why they left their jobs in the Philippines. Of 58 respondents who had worked in the country before going to the United States, 40 (69 per cent) indicated that they wanted to have more education and training. They wrote such comments as:

> To get further training.
>
> To further my medical specialty training.
>
> To obtain postgraduate education.
>
> Lack of academic stimulation.

Six respondents added the goals of "prestige and increased income" or"for better pay" along with further training. Six wrote down economic reasons as the major explanation for leaving their jobs in the Philippines, such as:

Salary too low.

If I continued to work there, I'll be old and gray and still not earn one-half of the expenses that went to my medical education.

Financial reason.

For greener pastures.

One gave as reason for leaving his job: "Disillusionment and disappointment with the general health system in the Philippines." Another mentioned "for better opportunities and to broaden my experience"; while a third said "I left originally for further training abroad, and for the second time because of frustration that I could not practice according to how I was trained in my specialty."

Seven gave personal reasons for leaving their work in the Philippines. Examples are:

To join my husband (or wife) in the U.S.A.

Long life-goal of coming to the U.S.A.

Being married to an American citizen, I believed it was best for the family to emigrate considering the increasing anti-American demonstrations and generalized disorder before Martial Law was declared.

The responses indicate that poor working conditions, inadequate training facilities, low compensation and limited professional advancement served as the "push" factors that impelled the MDs to leave their work in the Philippines. This inference is strengthened by the reasons they gave for leaving their jobs when viewed against the reasons they cited for leaving the country. In a sense, therefore, these also served as the "pull" factors that brought them to the United States.

Views on the Training and Employment of MDs

Questions about work experiences in the Philippines were asked in order to determine to what extent this might have contributed to the

brain drain. Fifty-eight (59.8 per cent) MDs had worked in the Philippines before going to the United States. Of this number, 20 (34.5 per cent) worked in private hospitals or for private firms (two of whom also taught in medical colleges); 19 (32.8 per cent) worked in government agencies or hospitals (with three who concurrently taught at the U.P. College of Medicine); 11 (19 per cent) were mainly in private practice (six of whom were part-time faculty members of state or private medical colleges); and eight (13.8 per cent) taught full-time in state and private medical colleges. Fifty-two (89.7 per cent) said they found work immediately after graduation. Five (8.6 per cent) reported that it took them six months to find a position, one indicated a waiting period of a year, and another mentioned two years.

Thirty (51.7 per cent) had occupied the position of resident physician before emigrating. Nineteen (32.8 per cent) had held teaching positions as instructors or assistant professors; one was a full professor. Six (10.3 per cent) reported other positions such as "volunteer" physician,[12] private company physician, senior staff member of a hospital,[13] and director of drug research in a pharmaceutical firm. The length of time they worked in the Philippines ranged from a few months to 14 years with most of them (39 or 67.2 per cent) working for one to two years.

Forty-five (77.6 per cent) of the MDs felt that the work they were doing in the Philippines was suited to their education and training. Thirteen (22.4 per cent) felt that the salary that they were receiving

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[12]This is an unpaid position in a public hospital.

[13]One was Chief of the Kidney Section of the University of Santo Tomas Hospital and was given an award as one of the Ten Outstanding Young Men in the Philippines in 1969 for his pioneering work in kidney transplantation.

was commensurate with their education and training and the requirements of their job. This was qualified by such comments as:

> I learned a lot.
>
> Given the years that I was in practice I felt I was adequately compensated then.
>
> Still part of my training to attain my goal.
>
> Enough for a single fellow.
>
> Appropriate during those years.
>
> Income was above average.
>
> I had reached the pinnacle of my profession as I was one of the pioneers in hemodialysis and kidney transplantation in the Philippines.

The last comment was made by the respondent referred to in footnote 13, who indicated that he was receiving an annual income of ₱100,000, the highest among the respondents.[14]

Those who felt that the salary they were receiving was not commensurate with their education and training numbered 44 (75.9 per cent). Of these, six received no salary as they worked as volunteer physicians. Fourteen who worked as resident physicians considered their salary (which ranged from free board and lodging only to ₱3,600 per annum) not commensurate to their education and training and the work demanded by their position. Some comments were:

> Too low salary for long hours.
>
> Net pay not even enough for board and lodging.
>
> My salary was even lower than that of the staff nurse.
>
> Salary below standard and work demanding.

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[14] Before 1970, this was approximately equivalent to US $25,641 at the exchange rate of US $1=₱3.90. From 1970, the exchange rate floated at US $1=₱6.70-6.76, hence, it became about JS $14,285 per annum.

> Residency position provided poor postgraduate training and inadequate salary.
>
> Salary was even lower than the minimum wage required by law for laborers.

Ten who worked as Instructors in medical colleges (and received salaries ranging from ₱3,600 to ₱8,000 a year) thought an MD in their position deserved better pay considering their eight years of college education and the expenses they incurred. One respondent who had reached the rank of full professor before emigrating commented that his salary (₱18,000 a year) was "not enough for a good standard of living." Two physicians who engaged in private practice in small towns had similar experiences and commented:

> In my hometown, many of the people are my relatives and family friends so they did not pay me. Instead, they gave me eggs, chicken, fish, choice fruits and vegetables.
>
> What do you expect when you practice in a small town? Your earnings are not even enough to pay your bills and medicines!

Thirty-two (55.2 per cent) of the MDs who worked in the Philippines had expected to find a better job than that which they actually held. The rest (26 or 44.8 per cent) said they had not expected to find better jobs. Thirty-eight (65.5 per cent) said their families and friends had expected them to find better jobs than they had held. Twenty (34.5 per cent) thought that this did not apply to them.

Training and Employment in U.S.A.

The immigrant MDs in the United States had to pass examinations administered by the U.S. Educational Council for Foreign Medical Graduates (ECFMG) before being allowed to undertake residency training or to hold equivalent positions in that country. Sixty-seven respondents (69.1 per cent of 97) indicated they had to pass these examinations before leaving the Philippines. The rest had to take ECFMG examinations after

a year of rotating internship in U.S. hospitals. Passing the ECFMG examinations and completion of two or three years residency training were still insufficient to qualify the Filipino MDs to practice medicine. They had yet to pass state licensure examinations or the Federal Licensing Examination in order to qualify. Those who wanted to specialize further in their medical practice had to undergo additional training and pass the specialty board examinations.

Thirty-four respondents (35.1 per cent of 97) rated their basic medical training in the Philippines as more or less equal to what can be obtained in the United States. Fifty-two (53.6 per cent) considered their medical education somewhat weaker than what can be obtained in the United States. Of this number, 15 (15.5 per cent) specified the basic medical sciences and training in research as the weaker aspects of their education. Seventeen (17.5 per cent) mentioned that Philippine medical students had less clinical exposure and experience in patient care compared with their American counterparts. Other respondents indicated such weaknesses in their basic medical education as inferior laboratory facilities and outdated periodicals. Only four MDs (4.1 per cent) rated their basic medical training in the Philippines superior to that obtainable in the United States and seven (7.2 per cent) rated it markedly inferior.

Thirty-five MDs (36 per cent) believed the advanced training they obtained in the United States is not available at all in the Philippines. Thirty-three (34 per cent) believed training opportunities in their field are quite limited in the Philippines. Nineteen respondents (19.9 per cent) felt that the advanced training they got is available in the Philippines but is not of the same quality. Ten (10.3 per cent) thought that equivalent training to that which they got in the United States is obtainable in the Philippines.

A majority of the respondents (89 or 91.8 per cent) reported they easily found work in the United States immediately after completing their residency training. Five reported waiting for one to two years before finding an appropriate position. Three respondents were then undergoing training under the Exchange Visitors Program and indicated they would be returning to the Philippines after completion. Of the 39 medical scientists in the sample, 21 (53.8 per cent) got teaching or research appointments right after their training in the United States. The rest were employed in hospitals as house staff and the like while undergoing more specialized training.

Thirty-four (36.6 per cent) of the 93 respondents who were working at the time they answered the questionnaire found their present position through friends and colleagues in the United States. Twenty-five (26.9 per cent) found their job while still undergoing training and 10 (10.8 per cent) learned of their position from advertisements. The rest found their work through personal inquiries (8 or 8.6 per cent), by invitation or offer from responsible officials (15 or 16.1 per cent), or by taking the Federal Civil Service Examinations (1 or 1.1 per cent).

Almost all (90 of 93 who answered the question) expressed satisfaction with the work that they were doing in the United States. Only three reported they were not satisfied.[15] Asked to explain or give reasons for their answers, the three respondents who were not satisfied with their work gave as their reasons:

> My immigration status prevents me from my full practice of opthalmology.
>
> I am involved in an academic program but I would rather do my own work than teach.

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[15]Four respondents undergoing further training did not answer the question.

I am not happy taking night calls in the emergency room.

Forty-four (48.9 per cent of 90) who were satisfied with their work gave reasons for their answers. Thirty-two (35.6 per cent) were satisfied because of the professional rewards. Some comments were:

> I am doing work that I trained for.
>
> I am doing what I like under optimum research and academic conditions and I feel that I am fulfilling myself professionally.
>
> I like the clinical and basic aspects and the income is adequate.
>
> I always enjoy teaching, with some private practice.
>
> My peers are satisfied. I am well rewarded and the community approves of me.
>
> Enjoyable, fulfilling and financially rewarding.
>
> It is challenging and the position I hold gives status.
>
> Challenging and keeps me abreast of the most recent advances in my specialty.
>
> It allows me to keep in close touch (with the profession) by active participation in academic medicine in a teaching hospital and I can combine this with my private practice.

Seven respondents (7.8 per cent) specifically mentioned such reasons as "good working conditions" like modern facilities, "good" company or hospital, and "economic rewards" which they considered satisfactory. The rest gave personal reasons for satisfaction with their work like:

> Most of all, my family is happy.
>
> By having interns and residents to take care of emergency aspects of medical care, I have time to raise my young family.

To get more insights into the activities of the MDs in the United States, they were asked to indicate how much of their working time was spent for medical practice, teaching, research, consulting or administrative responsibilities. Eighty-five answered this question. Of this

number, 29 (34.1 per cent) indicated that they were on full-time (100 per cent of working time) private medical practice, two (2.4 per cent) were full-time faculty members of medical colleges, one (1.2 per cent) was a full-time researcher,and two (2.4 per cent) were on full-time residency training. Eighteen (21.2 per cent) devoted 80 per cent of their working time to private practice and the remaining 20 per cent, to teaching combined with research or administrative work as part-time faculty of universities and teaching hospitals. Fifteen (17.6 per cent) said they devoted 60 per cent of their working time to private medical practice and 40 per cent to teaching or in combination with research or administrative work. Eighteen (21.2 per cent) were engaged mainly in teaching and research or administrative work alloting only 20 to 40 per cent of their working time to medical practice.

Most of the MDs earned over US $20,000 a year. This was net income before tax, that is, after deduction of expenses connected with their practice but before tax. Of 92 respondents who were willing to indicate their income bracket, 31 earned $21,000 to $40,000 while 30 earned $41,000 to $60,000 a year. Twenty-five earned over $60,000 a year. Those who earned below $20,000 a year were either in training or had just finished their training, while those who earned over $60,000 were either in full-time private practice or were engaged in private practice with part-time administrative and teaching or research positions. Table IX-7 shows the income levels in more detail.

Table IX-7
Annual Income of Immigrant Filipino
Physicians and Medical Scientists in U.S.A.

Annual Income (Net Before Tax) in U.S. dollars	Number of Respondents Reporting	Per Cent
Below $20,000	6	6.5
21,000 to 40,000	31	33.7
41,000 to 60,000	30	32.6
61,000 to 80,000	12	13.0
81,000 to 100,000	5	5.4
Above 100,000	8	8.7
Total	92*	100.0

*Five respondents did not disclose their income level.

Percentages may not add up to total due to rounding.

As can be seen, most of the respondents were well-established in their professional careers in the United States. They were also satisfied with the work they were doing and the income they were getting. Undoubtedly, these had important bearing on their future plans. To the question: "What are your future plans?", only nine (9.3 per cent) indicated they intended to return to the Philippines. One was already an American citizen, six were holders of permanent resident or immigrant visas and two were on the Exchange Visitors Program. Thirty-three (34 per cent) who were immigrants or permanent residents indicated they were planning to apply for American citizenship and would presumably settle in the United States. Fifty-one (52.6 per cent) simply answered they were going to stay in the United States. Of this number, 42 (43.3 per cent) were already U.S. citizens, eight were permanent residents and one was on the Exchange Visitors Program. Moreover, four of the American citizens were planning to sponsor the immigration of other members of their families to the United States. Five planned to retire

in the Philippines and one planned to return to the Philippines if "the opportunity should arise." Only four (4.1 per cent) were undecided about their future plans -- three of these were on immigrant visas and one was on the Exchange Visitors Program.

The respondents who indicated they planned to stay in the United States were asked when they made this decision. Of 84 who answered this question, 15 (17.9 per cent) said they had made it at the time they left the Philippines. Twenty-eight (33.3 per cent) said they made their decision to stay during the course of their advanced training. Twenty-six (31 per cent) decided after completing their advanced training. The rest (15 or 17.9 per cent) gave such varied answers as:

> After returning to the Philippines when I could not find a job. Even my own school turned me down for a teaching job.
>
> During my return to the Philippines, I felt that I could not continue to grow there professionally.
>
> After I got married and had a family, I made the decision to stay.
>
> After I got married to an American, I decided to stay.

The training period, therefore, seems to be the critical time when most of the prospective immigrants make their final commitment to remain in the United States or return to the Philippines.

The respondents were also asked about the ease or difficulty of getting professional licensure and obtaining work in the United States at the time of the survey compared with when they first arrived. This was intended to find out whether they were becoming concerned about the growing debate over the competence and role of foreign medical graduates (FMGs) in the delivery of health and medical care in the

United States.[16] To the question: "Do you think that the current atmosphere in this country (where you are now working) is better or worse than when you first came, in terms of getting professional licensure to enable you to practice your profession?", 48 (49.5 per cent) of the MDs answered the atmosphere was better; 26 (26.8 per cent) thought the atmosphere was worse; nine (9.3 per cent) considered it about the same as when they first came and 14 (14.4 per cent) said they did not know. Asked to explain or give reasons for their answers, 28 who thought the atmosphere was better gave such answers as:

> Doctors who are not U.S. citizens and even those on the Exchange Visitors Program can now take the state board of licensure examinations. (This was indicated by 17 respondents).
>
> As long as you are qualified, you can now get your license to practice. (Seven respondents mentioned this).
>
> There is more demand and more training facilities for medical personnel. (Four MDs gave this answer).

Nineteen who thought the atmosphere was worse volunteered their own explanations for their assessment. Nine cited the growing number of articles questioning the competence of FMGs; two gave economic problems such as unemployment and inflation as additional reasons; and ten mentioned the increased supply of medical graduates from American schools, and stricter examinations.

While many respondents thought it was easier to get professional

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[16] See, for example, Arlene Goldblatt, Louis Wolf Goodman, Stephen S. Mick and Rosemary Stevens, "Licensure, Competence and Manpower Distribution," New England Journal of Medicine, Vol. 292, No. 3 (16 January 1975), pp. 137-141; Procopio U. Yanong, M.D., "Medical Group Seeks Sharp Reduction of FMGs in the U.S.," Philippine Medical Association in Chicago Bulletin, Vol. XIV, No. 3 (May 1975), pp. 1, 6-8; Robert C. Derbyshire, M.D., "Warm Bodies in White Coats," Journal of the American Medical Association, Vol. 232, No. 10 (9 June 1975), pp.1034-1035; Robert L. Egan, M.D., "U.S. Citizens and Foreign Medical Schools," Journal of American Medical Association, ibid., pp. 1028-1030.

licensure in 1975 compared to when they first came, there were more who thought it had become more difficult to get jobs in their field of specialty. Forty-three (44.3 per cent) said it was more difficult to get jobs in their specialty, 32 (33 per cent) though it was about the same as when they first arrived, while 13 (13.4 per cent) felt it was much easier. Nine (9.3 per cent) respondents said they did not know. Twenty-nine of those who thought it had become more difficult to get jobs in their fields of specialty gave such reasons as the influx of foreign medical graduates to the United States and the fact that "the American institutions are starting to have an 'isolationist' attitude, that is, their own graduates and citizens come first." Other respondents (23), mentioned such reasons as the increased supply of American graduates and specialists in their field and economic reasons such as "recession", "slump", and the like.[17] Seven who thought it was easier to get jobs gave such reasons as "more demand for better medical care," "more hospitals being built," "more demand for specialty fields as rehabilitation medicine, neurology, psychiatry," and "still easy to get jobs in small towns but cities are saturated."

Views on Medical Training and Employment

The MDs were asked whether they thought that at the time they left the Philippines there were already opportunities to engage in the same type of work that they were doing in the United States. Forty-five of the 91 (49.5 per cent) who answered the question thought there were no opportunities at the time they left the Philippines for the same work they were doing in 1975; 29 (31.9 per cent) thought there were opportunities

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[17] Several respondents gave more than one reason, hence, there are more reasons than the number who gave negative assessments.

and 17 (18.7 per cent) said they did not know. They were also asked whether they thought similar opportunities in their field of specialty were any better than when they left the Philippines. Thirty-nine of 97 (40.2 per cent) did not know; 33 (34 per cent) thought opportunities were not any better. Twenty-four (24.7 per cent) felt that work opportunities in the Philippines had become much better compared to when they left the country. Of this last number, 16 indicated these improved opportunities were due to better facilities becoming available in the Philippines; eight considered them due to improved economic conditions. Additional reasons given were the improved peace and order situation; increased government spending on science education and research, the government's Medicare program; and increased demand for medical care among the people.

On the question of whether, with their advanced training and experience in the United States, they would easily find comparable work in Philippines if they returned, 40 respondents (41.2 per cent) answered "no"; 25 (25.8 per cent) said "yes"; and the rest (32 or 33 per cent) did not know. The respondents who gave affirmative answers were asked to choose from five possible explanations. Most (18 out of 25) chose "high prestige and status attached to advanced training and experience abroad by Filipinos." Thirteen checked "improved hospital, laboratory and research facilities in the Philippines." Other explanations were: "the Medicare program in the Philippines" (nine respondents),and "increased demand for quality health care in the Philippines" (eight respondents).[18]

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[18]The question allowed for multiple responses, hence, the discrepancy between answers and the number of respondents.

Those who thought they could not find comparable work in the Philippines offered their own explanations. Half of them (21 out of 40) mentioned work-related factors, like "lack of facilities" and "the underdeveloped state" of their fields of specialty in the Philippines. Twelve pointed to socioeconomic conditions in the country. Examples were: "Poor income of average Filipino"; "Health consciousness in the Philippines is about 50 years behind the United States"; and, simply, "It would be difficult to practice there because of the socio-economic conditions." The rest of the respondents mentioned factors related to the economics of professional practice such as: "too many physicians in Manila and the cities" (18 mentioned this); "poor financial rewards" (six gave this reason); and political interference in appointments to government positions, for example, "You need to have political 'pull' to get into available government positions"; and "It is not what you know but whom you know that is needed to get a position there."[19]

To the question whether they thought their advanced training would be helpful in the Philippines or would make them feel out of place, 86 (88.7 per cent) thought their advanced training would be useful in the Philippines, nine (9.3 per cent) thought it would make them feel out of place, and two (2.1 per cent) said they did not know. Those who thought their advanced training would make them feel out of place did so because they believed there was an oversupply of physicians in the Philippines. Other reasons given were the lack of equipment and facilities in their fields of specialty and the general political and economic situation. Fifty-two of 86 (60.5 per cent) who thought their advanced training would

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[19]The question was open-ended and several respondents gave more than one reason.

be useful in the Philippines specified their reasons for thinking so. These were: the "need and demand for services" in their respective fields of specialty (26 respondents); "advanced training is always useful" (five respondents); with their advanced training they felt that they "can teach colleagues and help upgrade medical education" (eight respondents); and "the need for basic and applied research in the Philippines" (one respondent). Four respondents thought their training would be definitely useful in the Philippines but they would feel out of place because of a perceived oversupply of physicians in the country.

Views on the Brain Drain and Relevant Policies

The MDs were asked whether they were aware of any government policy adopted to bring home emigrant Filipino scientists, engineers and medical personnel. Eighty-four of 96 (87.5 per cent) respondents indicated they were unaware of such government policy. Of 12 (12.5 per cent) who claimed they knew of such policy, eight mentioned the Balikbayan (returning residents) program of the Department of Tourism while others mentioned the government's Medicare program and the establishment of the Philippine Heart Center for Asia. One respondent revealed that he had been informally asked by government officials what it would cost to bring him back to the Philippines.

Interestingly, although only 12 respondents were aware of any policy to bring home scientists, 47 (49 per cent) answered the question on whether they think such a policy would be effective or not. Of this number, one thought such a policy would be highly effective; 13 felt it would be effective; 21 thought it would be somewhat ineffective; and 12 felt it would not be effective at all. Among those who thought such a policy would be ineffective or not effective at all, 29 gave reasons. Eleven gave reasons related to the country's present political climate

such as:

> It will not work where freedom is restricted.
>
> Unstable government; don't like dictatorship.
>
> Graft and corruption in and out of the government.
>
> Forced return of professionals will never work.

Eight respondents gave economic reasons like:

> Government cannot support scientists.
>
> The Philippine Government cannot and will never give us the money we are earning and opportunities for professional growth.
>
> Effective or not, I don't really care. There is nothing wrong with Filipinos emigrating to improve their way of life.
>
> Emigrants disillusioned with Philippine economy, opportunities, chances of progress after experiencing U.S. pace of success.

Three respondents gave reasons related to the scientific establishment:

> The old folks are resistant to 'upstart' scientists.
>
> Because appointments in prestigious positions are through political connections and influence.
>
> It is not a question of government policy. Research, I feel, is a luxury for a developing country.

Seven respondents who thought that any government policy designed to bring home emigrant scientists, engineers and medical personnel will not be effective gave more realistic reasons, such as:

> When Filipino physicians have stayed for five to ten years after training in medical schools in U.S.A., the chance of their going back is pretty poor.
>
> As far as my specialty is concerned, it would be ineffective.
>
> Such a policy is not for those who have settled in the U.S.A. with a house, investments and family; it should be for the new graduates.
>
> Government intervention is not a good motivation to bring home scientists, doctors and other professionals; more financial support is needed for those who are just

> finishing their training. If they have places to go back to, (the policy) would be effective, but not for those who have practiced here. It is now getting harder to get into hospitals in the U.S.A. for those who have not taken the ECFMG examinations.

Six who thought a policy to attract emigrant scientists back home would be effective gave their own reasons, and one respondent asserted that some Filipino scientists and medical personnel had actually gone back to the Philippines. Three gave as reasons for the effectiveness of a policy to bring home Filipino scientists the improving economic conditions in the country. For example:

> I think we are starting to move toward industrialization. The middle class sector (hopefully) will enlarge, there will be more demands for better care thru research and our medical ills are not the same as those of the U.S.A., Canada or Europe.

> Because of the Medicare Program, there are now more patients who can pay.

The respondents were presented with a list of six hypothetical policies which the government could adopt to attract home emigrant Filipino scientists, engineers and medical personnel. They were asked to state whether such policies would contribute greatly, somewhat or not at all towards achieving this objective. Over two-thirds of the respondents agreed that the hypothetical policies would contribute greatly to bring home emigrant scientists, engineers and medical personnel. The policy which got the highest number of approving respondents (79 out of 94 or 84 per cent) was: "Create more facilities for high training of science manpower in the Philippines,e.g. residency programs for MDs and provide financial support for deserving scientists to take advantage of such training in the country." Table IX-8 shows the distribution of responses to the hypothetical policies presented in the questionnaire.

Thirty-five respondents (36.1 per cent) indicated they would re-

commend most strongly the increase or upgrading of salaries of scientists, engineers and medical personnel in government agencies and offices in order to bring home emigrant scientists. A small number (28 or 29.2 per cent) chose the creation of facilities for high training of science manpower in the Philippines as the priority policy which they would recommend for adoption.

Only 36 (37.1 per cent) respondents volunteered their own recommendations for reforms in the medical curriculum to suit it to Philippine needs and conditions. Eleven mentioned the desirability of reorienting the medical curriculum to emphasize the study of infectious diseases, tropical medicine and community medicine. Other respondents commented on the need to "ensure better teaching of the basic sciences; earlier and better teaching of clinical sciences; more independence and less spoonfeeding of students;" and to "offer more elective courses in medical schools and make students participate in researches and pursuit for academic excellence." Ten pointed to the necessity for expanding post-graduate or residency training in all the fields of medicine. As one respondent reasoned:

> The time to keep physicians in the Philippines is when they are 25-35 years old. Therefore, it is necessary to provide a meaningful program of postgraduate training for all medical graduates. Even if these physicians leave the country for some further training after residency, their chances of returning will be higher as their ties with the Philippines will be greater.

Ten urged the upgrading of schools, teaching hospitals and research facilities in the country. One stressed this as part of his package of policy recommendations. He advocated that the government should "distribute medical facilities (high quality medical centers) in different regions instead of concentrating them in Manila, with adequate training facilities in different specialties." Moreover, the government

Table IX-8
Opinions of Immigrant Filipino Physicians and Medical Scientists in U.S.A. on Hypothetical Policies to Bring Home Emigrants

Policies	Contribute Greatly	Contribute Somewhat	Not At All	Total Giving Opinions*
1. Increase or upgrade salaries of scientists in government offices and agencies.	67	23	3	93
2. Eliminate political patronage or interference in appointment and promotion of scientific personnel.	74	18	2	94
3. Increase government spending for scientific research and development to encourage more scientific activity.	76	15	3	94
4. Reorganize government science agencies to eliminate red tape in the conduct of scientific research and implementation of science projects.	72	20	3	95
5. Improve general peace and order situation in the country.	63	25	4	92
6. Create more facilities for high training of science manpower in the Philippines, e.g. residency programs for MDs, and provide financial support for deserving scientists to take advantage of such training within the country.	79	13	2	94

*Not all the 97 respondents expressed opinions on all the items.

should encourage "the involvement of scientific and medical associations in these regional centers and upgrade the school system, that is, no 'diploma mills'."

One MD observed: "It is not a question of changing the (medical)

curriculum, but ... one of availability of facilities for training and treatment centers. If these are available, higher endeavors, like research, will follow." Others made recommendations relating to the need to reduce enrollment in medical schools, the use of textbooks geared towards common illnesses in the Philippines, the importance of upgrading faculty, "full-time faculty instead of part-time or 'accidental teachers'," and to "eliminate political patronage in appointments."

The respondents were also asked whether they were aware of any recent government policy to stop scientists, engineers and medical personnel from leaving the Philippines. Fifty-five (56.7 per cent) indicated that they were unaware of such policy; 39 (40.3 per cent) said they were aware;while three did not answer the question. Among those who said they were aware of such policies, 16 (16.5 per cent) mentioned the government requirement for all new medical and nursing graduates to serve in rural areas before they can leave the country.[20] They indicated varying information on the duration of this rural service. Others mentioned having heard of restrictions on the issuance of exit papers and news about suspending ECFMG examinations in the Philippines.

Although there were many respondents who were unaware of any government policy to stop the brain drain, 70 (72.2 per cent) answered

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[20]Introduced in 1974 as part of the Department of Health's Rural Health Practice Program, compulsory rural service was made a prerequisite for taking the medical or nursing board examinations. Medical graduates must serve in the rural areas for six months (nursing graduates serve for four months). See Department of Public Information, The New Society of the Philippines, Philippine Briefings No. 1 (Manila: January 1975), p. 8; Nestor N. Pilar, Emma G. Boncaras and Grace P. Santos, "Social Development Policies and Programs in the Philippines: Focus on the Delivery of Health Services"; SPAR Report No. 7 (Manila: University of the Philipines, College of Public Administration, September 1976, mimeo.), p. 34.

the question whether such a policy would be effective. Twelve (12.4 per cent) thought such a policy would be highly effective; 31 (32 per cent) thought it would be slightly effective; 17 (17.5 per cent) indicated it would be quite ineffective while 10 (10.3 per cent) believed it would not be effective at all. On the question of what steps the government might take to tackle the brain drain problem more effectively, only 23 (23.7 per cent) respondents offered suggestions. Nine mentioned the need to improve economic incentives like salaries, fringe benefits and the like, to encourage Filipino MDs, scientists and engineers to remain at home. Six recommended control of travel by Filipinos abroad by limiting or stopping the issuance of passports and other exit papers; the rest gave proposals on the improvement of hospitals, schools and training centers.

Five hypothetical policies which the government could adopt were presented to the respondents, and they were asked to indicate whether they approved or disapproved of each one and how effective it might be. Most (89 or 91.8 per cent) approved of a policy to "create more jobs for science graduates by increasing government spending on scientific research and development for industry as well as for agriculture." Fifty-one (57.3 per cent of 89) believed such policy would be very effective; 35 (39.3 per cent) thought it would be somewhat effective. A policy to "require all new graduates in science, engineering and medicine to practice their professions or accept government posts in rural areas for a number of years as a condition for the granting of passports and/or exit papers," received the approval of 47 (48.5 per cent) respondents. Of 89 who answered the question, only 13 (14.6 per cent) believed it would be very effective, 41 (46.1 per cent) thought it would be somewhat effective, and 31 (34.8 per cent) thought it would be ineffective. Fifty-

two (58.4 per cent) answered a follow-up question on how many years this compulsory rural service should be. Thirty (33.7 per cent) recommended two years, 14 (15.7 per cent) suggested one year and the rest indicated (two respondents for each category), "six months," "three to four years," "five years," and "ten years." Table IX-9 shows the opinions of respondents on the hypothetical government policies to stop the brain drain or emigration of scientists, engineers and medical personnel.

The respondents were also asked what additional policies they would recommend for stopping the brain drain in their own field of practice. Thirty-six (37.1 per cent) gave their own proposals. Ten recommended the creation of more jobs, increased salaries, better opportunities for advancement and professional recognition. Three advocated the adoption of compulsory private or government health insurance to assure doctors of income or payment for their professional services. Five proposed the improvement of facilities for postgraduate and residency training and commensurate salaries for these positions. Six recommended some form of control on travelling scientists like "the signing of a contract to return after training; failure to do so would mean cancellation of their passports and automatically subject them to repatriation." Moreover, one recommended that such control(s) should be tied up with good financial opportunity and appropriate work upon the scientists' return. There were some other proposals, but they were too general for the purpose of this study.[21]

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[21] Examples of such proposals were: "Instill strong sense of nationalism"; "Stop political interference and optimize budget"; and others.

Table IX-9
Opinions of Immigrant Filipino Physicians and Medical Scientists in U.S.A. on Proposed Policies to Stop Emigration of Filipino Scientists, Engineers and Medical Personnel

Proposed Policies	Approve	Disapprove	No Opinion	Total
1. Compulsory rural service for new graduates in science, engineering and medicine before issuance of passports or exit permits.	47	42	8	97
2. Regulate enrollments in universities and colleges to match the number of available jobs in public and private sectors.	62	29	6	97
3. Restrict enrollment of students in all universities and colleges and increase the number of government scholarships for undergraduates in priority fields of science.	71	20	6	97
4. Revise science, engineering and medical curriculum to make them more attuned to Philippine socioeconomic needs and conditions.	82	9	6	97
5. Create more jobs for science graduates by increasing government spending on scientific research and development for industry and agriculture.	89	3	5	97

Views on Scientists and Science Policy

Statements concerning scientists, engineers and medical personnel, and government science policy were presented towards the end of the questionnaire. The MDs were asked to indicate how far they agreed or disagreed with the statement. The purpose of the question was to try to elicit some sense of the values that MDs have as individuals and as

citizens or nationals of a country. The results showed that 70 (75.3 per cent of 93) agreed with the statement: "The Philippines is not losing much from the brain drain of individuals like myself as there is no available work or suitable employment and commensurate compensation for us back home." Of this number, 57 (61.3 per cent) indicated that they "strongly agree" while 13 (14 per cent) "agree" with the statement. Only 12 (12.9 per cent) disagreed with the statement, nine "strongly". The other statement on which there was much agreement was: "There is nothing unpatriotic about working in a foreign country since a scientist's loyalty is towards science."[22] Sixty-nine (79.3 per cent of 87) agreed with this statement, 50 (57.5 per cent) of them "strongly". Four disagreed, with only one indicating strong disagreement. Sixty-four (68.8 per cent of 93) respondents (with 45 or 48.4 per cent who "strongly agree"), agreed with the statement:"The Philippine government should not stop the emigration of Filipino scientists, engineers and medical personnel as they have the right to maximize the economic benefits derived from their personal investment in education and training." The statement: "I think of myself as an individual with economic needs, family obligations first and a scientist second," elicited the agreement of 65 (73.9 per cent of 88) with 43 (48.9 per cent) indicating "strongly agree." Table IX-10 shows the distribution of responses to the seven statements.

Thus, the medical scientists and physicians tended to place the greatest importance on personal and individual considerations in their decision on the place and type of work they would like to do. Being

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[22]This statement and items 2, 3 and 5 in Table IX-10 were presented in a survey of scientists in Britain. See Stephen Cotgrove and Steven Box, Science, Industry and Society (London:George Allen and Unwin Ltd., 1970), p. 186.

Table IX-10
Opinions of Immigrant Filipino Physicians and Medical Scientists in U.S.A. on Selected Statements About Scientists and Government

Statements	Degree of Agreement with Statements					Total Giving Opinions*
	Strongly Agree--1	2	3	4	Strongly Disagree--5	
1. There is nothing unpatriotic about working in a foreign country since a scientist's loyalty is towards science.	50	19	14	3	1	87
2. The values of science sometimes conflict with jobs government requires scientists to work on.	34	23	22	3	7	89
3. The policies of national government frequently interfere with exchange of scientific knowledge across national boundaries.	29	19	20	8	10	86
4. I think of myself as an individual with economic needs, family obligations first and a scientist second.	43	22	15	4	4	88
5. I think of myself as a scientist first and as a member of a nation second.	27	14	23	7	15	86
6. The Philippines is not losing much from the brain drain of individuals like myself as there is no available work or suitable employment and commensurate compensation for us back home.	57	13	11	3	9	93
7. The Philippine government should not stop the emigration of Filipino scientists, engineers and medical personnel as they have the right to maximize the economic benefits derived from their personal investment in education and training.	45	19	14	9	6	93

*Not all the 97 respondents expressed opinions on all the items.

members of the scientific community comes only as the second consideration, and being members of a nation comes next.

The lengthy comments which some respondents volunteered at the end of the questionnaire tend to support the above generalization and provide additional insights into their perceptions of scientists, science and relevant government policies. Economic considerations surfaced as a very important reason for emigration of MDs. As one expressed:

> I don't agree at all with such policies of preventing people to get out of the country. I think individuals should have the freedom to choose where they want to go. Majority of the Filipino MDs here came back after being frustrated at home economically. Some people who became successful in their fields at home probably have political influence to back them. I am happy here. I don't think I will ever make the same amount of money that I am making here if I were to go home. I don't want to sound unpatriotic because I will fight anyone who says anything derogatory about the Philippines and Filipinos. I am still a Filipino although my citizenship has changed. But I am not for Martial Law either and I hope other prospective emigrants would be given a chance. Returning home should be voluntary.

Another commented: "Brain drain will always be a fact of life as long as the pastures on the other side of the fence remain greener!"

Frustrations with the situation in the Philippines, whether directly related to the economic and political conditions or simply to professional goals,were also brought out by some as the cause of brain drain. For example, one MD wrote:

> I am staying here in the U.S.A. because there is no suitable atmosphere in the medical sciences in the Philippines. When I was a student, there were no mentally honest individuals and physicians.

Another explained:

> The professionals and scientists in the U.S.A. have a basic dread of going back and not being able to assimilate and excel in their line of work. This could be overcome, but with the additional problems of personal and academic freedom, the decision (not to return tc the Philippines) has become more easily arrived at.

These comments were reinforced by policy recommendations offered by several respondents. Some of these were:

> The Philippine government should concentrate on increasing its efforts to improve socioeconomic conditions, educational opportunities and political stability in the country in order to attract scientists to go home.

> The government should clean itself first from the highest to the lowest (rank) and develop the socioeconomic situation to bring in more people to middle class (level). Martial law is alright as long as it is taken to improve the situation and not to put your opponents down.

> Rather than restrict these scientists from pursuing further training in their respective specialties, the government should encourage them to do so and also to encourage them to return home and not by enacting laws that infringe on individual liberty.

More specific recommendations were given by three respondents. These actually have direct relevance to the Balik-Scientist Program discussed below, albeit they were given before the program was enacted. One MD stated:

> The chance of being able to have an effective science policy should not be completely left in the hands of the government. An input from the private sector is a must.

Two MDs who maintained that their options of returning home were still open wrote:

> I would be willing to return and invest my training, experience and knowledge in the Philippines and share them with my compatriots now if assured that an opportunity to work in my field is available, not necessarily with the same amount of financial gain.

> I had always wanted to go home and practice in the Philippines while I was on training but I have not generated enough financial support (as salary for university-based training is very much lower than for others) for transportation and relocation expenses. This is one of the examples that need government support to discourage brain drain.

B. Survey of Balik-Scientist Participants

Participants of the Balik-Scientist Program were also surveyed to gain insights into their perceptions of science policy and the education

and training of scientists and engineers in the Philippines. The program has its roots in the growing concern over the increasing emigration of Filipino scientists, engineers, physicians and other professionals to other countries, especially the United States and Canada. The spate of news reports, articles, discussions of the continuing brain drain was especially noticeable in the mid-1960s and has continued during the 1970s. In spite of this concern, however, there was a dearth of reliable information on the magnitude and causes of the emigration of scientists and professional manpower.

Studies of Brain Drain in the Philippines

Since 1967, there have been several studies conducted to find out the extent of the brain drain in the Philippines[23] and to identify the factors associated with the emigration of scientists and engineers.[24] Two studies had similar findings on the incidence of emigration.[25] Both found that the brain drain was moderately serious, involving mostly those who went abroad for graduate studies. Students who enjoyed fellowship

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[23]See, for example, Walden F. Bello, Frank Lynch and Perla Q. Makil, "The Brain Drain in the Philippines," Modernization and its Impact in the Philippines, IV (Quezon City: Ateneo de Manila Press, 1969), pp. 93-142; 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), pp. 167-191; Ernesto M. Pernia, "The Question of the Brain Drain from the Philippines," International Migration Review, Vol. X, No. 1 (Spring 1976), pp. 63-72.

[24]Josefina R. Cortes, "Factors Associated with the Outflow of High Level Philippine Manpower," Philippine Sociological Review, Vol. 18, Nos. 3-4 (July-October 1970), pp. 155-166; and her "Brain Drain and Counter Brain Drain in the Philippines," Papers and Proceedings of the Workshop on Manpower and Human Resources, The Philippine Economic Journal, Number Twenty Three, Vol. XII, Nos. 1-2 (1973), pp. 627-649.

[25]Bello, Lynch and Makil, op. cit.; Cortes, op. cit.

support from the Philippine or host country government during their studies abroad and who had jobs waiting for them in the Philippines were found less likely to emigrate. These findings were reinforced by those of a 1973 study on foreign-trained professionals who were employed in the Philippines.[26]

The three studies cited above[27] made similar policy recommendations to stem the brain drain and encourage highly-trained Filipinos to return home. One was to set up a communications and placement center to inform Filipino students abroad on activities and job opportunities in the Philippines in their fields of specialization. Another suggestion was that government scholarships for study abroad should be granted to qualified persons who are already employed at the time of their selection. It was emphasized that there should be a systematic job placement for returning Filipino scientists and professionals. Moreover, there was a need to improve working conditions in the country, particularly in colleges and universities, and to establish a center for advanced studies in the sciences, engineering and related fields to minimize the need for studying abroad.

The Balik-Scientist Program

Undoubtedly, studies of the brain drain contributed to the establishment of the government's Balik-Scientist Program (BSP) in October

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[26]Cristina P. Parel, A Report on the Survey of Foreign-Trained Professionals and Their Employers in the Philippines (Quezon City: U.P.-NSDB Project No. 7303-ED, n.d., mimeo.).

[27]Bello, Lynch and Makil, op. cit.; Cortes, op. cit.; Parel, op. cit.

1975.[28] An interagency program involving NSDB, Department of Tourism (DOT) and Professional Regulation Commission (PRC), the BSP aims to attract foreign-based Filipino scientists and professionals to visit the Philippines in order to learn about the opportunities for employment and professional practice and eventually to return to the country for a longer or permanent stay. The program is managed by a Coordinating Staff composed of three action officers representing NSDB, DOT and the Association of Colleges of Agriculture in the Philippines (ACAP). NSDB's Financial and Management Service Chief acts as the Chief Coordinator of BSP. The two other members of BSP's coordinating staff are the Officer-in-Charge of DOT's Balikbayan Program and the Executive Secretary of ACAP.

The program consists of two phases. Phase I is an invitational period of two weeks designed to give prospective returnees a chance to see for themselves the economic, political and social conditions in the Philippines, to assess the country's scientific and technological advancement and to confer with prospective employers. Phase I awardees are given round trip air fares from their country of origin to the Philippines, maintenance and transportation allowance in the Philippines for two weeks. These allowances are tax-exempt. They are given a pre-arranged itinerary as guests of the Philippine government

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[28] Presidential Decree No. 819, 24 October 1975. For details on the genesis of this program, see Olivia C. Caoili, "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, mimeo.), especially pp. 4-8. The Republic of Korea has its own program for reversing the brain drain but proponents of the BSP seemed unaware of its existence. See Harriet Hentges, "The Korea Institute of Science and Technology: A Case Study in Repatriation," International Development Review/Focus, Vol. XVI, No. 3 (1974/3), pp. 27-30.

for one week and allowed one week on their own schedule. In exchange for these benefits, they are to give consultancy services (through the BSP Secretariat) to requesting firms and agencies, television and radio interviews and talks with prospective employers. Upon their return to their foreign residence, BSP grantees are required to submit to NSDB an evaluation report on their observations pertaining to their fields of specialization and to indicate their intention to return to the Philippines. There are 32 available slots annually for this phase of the program.

Phase II of the program involves a longer,possibly more permanent stay in the Philippines. The financial benefits to participants under this phase include one-way air fares for the grantee, his/her spouse and two direct dependents; freight expenses for personal and household effects for each family; relocation allowance in the Philippines covering travel expenses from Manila to the place of employment; a reimbursable amount for the purchase of professional books and equipment within one year of arrival and duty-free entry of one used motor vehicle which the returnee owns, and registered in his name, at the time of approval of his application to the BSP.[29]

In addition to the above benefits, a participant under Phase II will be granted license to practice his profession in the Philippines provided he registers with the Professional Regulation Commission and pays the required registration fee. Moreover, he is assured support for research projects approved by NSDB or PCARR; a travel exit permit

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[29]National Science Development Board-Department of Tourism, Balik-Scientist Program, Annual Report, 1976 (Taguig, Metro Manila: 1976, mimeo.), pp. 7-8; and "Rules and Regulations Implementing Presidential Decree No. 819," in ibid., appendix.

once a year to renew his/her residence status abroad or for emergency purpose and tax credits for foreign income taxes provided the corresponding income is declared in the Philippines. Over and above these, the awardee is also entitled to privileges and benefits granted to overseas homecoming Filipinos under the existing Balikbayan Program which are not covered by Presidential Decree No. 819.

There are 16 available slots for Phase II each year. Forty per cent of these are reserved for agriculture (6 slots) and the remaining 60 per cent are distributed evenly between engineering and industry (5 slots) and other fields (5 slots). In the BSP's first Annual Report covering fiscal year 1975-76, 16 participants were listed under Phase I (50 per cent of available slots) and 17 participants under Phase II (over 100 per cent of slots).

The BSP Coordinators had anticipated that Phase I slots would be in greater demand than Phase II slots. As it turned out, there were more applicants for Phase II of the program. The Chief Coordinator remarked: "We anticipated a lot of free loaders but we actually have more applicants for Phase II than there were available slots." He speculated that perhaps the hiya (sense of shame) system also works in the program. Thus,"having left the country to work for another country, Filipino scientists are ashamed to come home for free."[30] He observed that Phase I participants insisted on being given their round trip ticket right away. He noted that they feared they might not be allowed to return to the United States once they had entered the Philippines. He said that the BSP's correspondence with Phase I participants who have

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[30]Interview with Mr. Agapito Perez, Chief Coordinator, Balik-Scientist Program, NSDB, Metro Manila, 31 May 1976.

gone back to the United States has been favorable. He revealed that NSDB was not really in favor of Phase I of the Program but President Marcos wanted it included to enable Filipino scientists to see for themselves the progress that had been achieved in the Philippines during their absence. While all Phase I participants had expressed their desire to come back under Phase II of the program, the Chief Coordinator admitted: "We are not so certain of their sincerity."

Survey of BSP Participants

In order to get more insights into the operation of the program, a survey was made of BSP participants in both Phases I and II, during its initial year of operation, fiscal year 1975-76. This was done by means of questionnaires and interviews. A list of names and addresses of participants was secured from the BSP Secretariat in July 1976. At the time of the survey, 14 participants were listed under Phase I.[31] Twelve of these were in the United States and two were in Canada. All were sent questionnaires with self-addressed and stamped return envelopes. The rate of return for Phase I respondents was six out of 14 (42 per cent).

For Phase II of the program, the BSP Secretariat's list at the time of the survey included 21 names even if there were only 16 slots available each year for this group. Of this number, four were interviewed and 17 were sent questionnaires. Twelve of the latter responded. The rate of return for this group was 16 out of 21 (76 per cent). If one looks at the BSP's Annual Report for 1975-76, all but one of the 17 listed participants for the first year (94 per cent) responded to the survey. In addition, two participants for 1976-77 were interviewed

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[31] In its published Annual Report which came out in December 1976, the BSP Secretariat listed 16 participants. Questionnaires were sent out from the University of the Philippines at Los Baños in October 1976; follow-up letters were mailed in December 1976.

because of their accessibility. Their responses were included in this analysis. There were thus 18 respondents for Phase II.

Background of Participants

What sort of persons participated in the BSP during its initial year of operation? An analysis of survey results showed that a third of the respondents (eight out of 24) were females. Most (3 Phase I and 11 Phase II respondents) were 26-35 years old, with 8 being 31-35 years of age. The rest were 36-45 years old.

All respondents obtained their bachelor's degree in Philippine universities or colleges. Twelve (three Phase I and nine Phase II participants) were graduates of the University of the Philippines. A majority of Phase II respondents (13) had majored in agricultural sciences (including four in agricultural education) in their undergraduate courses. Three had obtained Master's degrees from Philippine universities before leaving for the United States.

Five of the six Phase I respondents listed Metropolitan Manila as their place of work before leaving the Philippines compared to four of the 18 Phase II participants. All six Phase I respondents had worked in the Philippines before emigration with four having worked for three to four years. Sixteen Phase II participants had worked in the Philippines before going abroad. Five of them had worked for less than three years, six had worked from four to six years, one had worked for seven years, two for 10 years, and two for 16-17 years.

When asked what were their reasons for leaving the Philippines, four Phase I participants mentioned "to get further education or training" as the primary reason, one indicated "to have better employment opportunities" and one said "dissatisfied over work in the Philippines." Two had obtained their M.S. degrees abroad (one in cell biology from a

U.S. university and one in engineering hydraulics from the Asian Institute of Technology in Bangkok); one was a Ph.D. candidate in nuclear chemistry and one had a Ph.D. in civil engineering, both of these taken in the United States. Their length of stay in the United States ranged from three to 12 years, four of them having stayed from eight to 12 years. Two were already American citizens, three were permanent residents and one had a student visa.[32] Of the three permanent residents, two indicated that they were planning to apply for U.S. citizenship. The five who were U.S. citizens or permanent residents were employed in the United States at the time of the survey -- two in research positions, one as a project engineer, one as professor in a state university and one as a department head in a hospital.

Two-thirds (12) of the Phase II participants obtained their Ph.D.s from universities in the United States. Of the rest, one obtained a Doctor of Education, five got their M.S. degrees, and one attended a nondegree training program. Ten of the 12 Ph.D.s were in the natural sciences, one was in agricultural economics and one in agricultural education. Their length of stay abroad ranged from two to 15 years with 10 of them indicating a stay of five years and over. All gave as primary reason for leaving the Philippines: "to obtain further education and training." Secondary reasons for leaving the country were: "to have better employment opportunities"(mentioned by five) and "dissatisfied over work in the Philippines" (four respondents).

On their work experience abroad, 11 Phase II participants reported

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[32]The student visa holder returned to the Philippines under Phase II of the Program after finishing her Ph.D. in nuclear chemistry. She joined the Philippine Atomic Energy Commission.

that they worked after finishing their degrees (or advanced training) for periods ranging from six months to 11 years. One worked as senior scientist at the National Aeronautics and Space Administration, four worked in research positions in universities, two as associate professors in state universities, one was research specialist in a mining agency, one was a geologist, one was agronomist and one was a library assistant. Most of them found their work right after finishing their degrees with one reporting a waiting period of two years before finding work. Of the 11 who worked, six indicated that they found their employment through friends or colleagues, three learned about it while on training and two simply wrote letters of application.

Prospects that Balik-Scientists Will Remain

How likely are the Balik- Scientists going to stay in the Philippines? From the background information on respondents in both phases of the BSP, it can be seen that Phase I participants were much more exposed to metropolitan living and working conditions before going abroad. Among the 18 Phase II respondents, their work experience was much more varied in terms of geographical location and more oriented to agricultural/rural setting. Most of them had also worked for longer periods in the Philippines compared to Phase I participants. In this sense, it may be inferred that their attachment to the country is much stronger than those of Phase I respondents. The fact that most Phase II respondents got advanced training in fields that are especially focused on agriculture and natural resources tends to help them adjust more readily to the increasing work opportunities in the Philippines. Thus, they are more likely to remain longer if not permanently in the country.

The probability that Phase II respondents will stay in the Philippines may also be inferred from their more positive perception of existing

employment opportunities in their fields of specialization and the worth of their advanced training in the country. This is all the more significant considering that the majority had worked abroad before coming home and expressed satisfaction with the work they were doing there. Only two of the 11 Phase II participants who had worked abroad were dissatisfied with their jobs there. They gave reasons as "work not directly related to my field" and "had to work so as not to leave the place." Among those who said they were satisfied, four indicated it was because what they did was in line with their field of specialization; two mentioned that their work "was challenging"; and two gave "good pay and facilities" as reasons.

All the respondents thought that their advanced training would be useful in the Philippines. However, their perceptions of improved job opportunities in their field of specialty in the Philippines differed. Three Phase I participants thought that work opportunities in their field were better at the time of the survey than when they first left the country. The main reason given for this was the "increased role of scientists in the Philippines." The three who thought employment opportunities were not any better than before gave reasons like the continued existence of "bureaucratic practices that hamper individual work" and "no increase in government budget for my field." In contrast, 15 (of 18) Phase II respondents thought that work opportunities in their fields were much better than when they first left the country. Allowing for multiple responses, the reasons mentioned most often were: Increased role of scientists in the Philippines" (12); "increased government spending on science, education and research" (10); "improved economic conditions in the Philippines" (6); "improved peace and order situation" (6); and "better facilities in the field of specialty now available" (4).

At the time of the survey, 15 Phase II respondents were employed as full-time faculty members in state universities and colleges. Six were at the University of the Philippines (U.P.) at Los Baños; one was at the U.P. in Diliman, Quezon City; six were at the Visayas State College of Agriculture; and two were at the Central Luzon State University. Two scientists were employed as researchers at the Southeast Asia Fisheries Development Commission; both indicated they were also part-time faculty members in private universities. One respondent was working for a private corporation.

Only two Phase II participants were dissatisfied with their work and gave as reasons: "my work is not very relevant to my training although it pays well" and "administrative constraints limit returns to research." The latter comment is not very clear and may mean too much time is required for the scientist's administrative duties and too little for research. Of those who expressed satisfaction with their work, ten gave as reasons work-related factors such as being able to do research in their line of interest, full support from their supervisors, "challenging work" of helping to build up faculty and research capability of their schools and the like. One qualified his positive answer by saying "up to a point, because I feel my expertise (geology) is not appreciated by the government which calls in foreign experts to do the work that I or others in my field can do as well."

Comparison of Working Conditions Abroad with the Philippines

Of particular interest for the BSP's effectiveness as a policy is the extent to which Filipino scientists may be coming home only because of their perceptions of tightening work opportunities abroad. It is possible that they are coming home because they have no better prospects at the moment and, therefore, their stay may be temporary rather than

for good. To get an insight into this, the question was asked: Do you think that the current atmosphere in the country where you worked before coming home is better or worse than when you first went there in terms of opportunities to get advanced training or professional qualifications which would enable you to practice your profession or get equivalent work? To this, four of the six Phase I respondents (who had fairly well-established careers) answered that the "atmosphere is better." One felt it was "worse as employment opportunities were better 10 years ago."

Among the Phase II respondents, seven did not answer the question because they did not have any work experience abroad. Of the 11 who worked abroad after their advanced degrees, six thought that the "atmosphere was better," one felt there was no considerable change and four felt that the "atmosphere is worse." Among the reasons given for this negative assessment were: "because of increasing unemployment," "more strict requirements," "keen competition," and "more preference for American rather than foreign students."

A related question was: Do you think that at present it is easier to get jobs in your field of specialty in the country where you are working now (or where you worked before coming home) compared with when you first went there? They were also asked to give reasons for their answer. Five Phase I respondents said it was more difficult to get jobs at the time of the survey because of a "tight job market," "economy was better then," and "the employer has the advantage because of more supply of trained people." Understandably, only the 11 Phase II participants who worked abroad answered this question. Three felt it was easier to get jobs in 1976. These were in the fields of geology, educational media and plant pathology/microbiology. Six felt that it was more difficult to get jobs because of "economic reasons," "keen competition for jobs

because of oversupply (of scientists)" and "preference for American citizens." One respondent felt the situation was about the same as when he first arrived. One said he did not know.

The data show that the scientists were not coming back to the Philippines because of a perceived negative atmosphere for scientists abroad. What these indicate is that, it would perhaps be difficult for those who would be entering the foreign job markets for the first time. The fact that those who answered the question were all working and, as has been shown, were generally satisfied with the work they were doing abroad suggests that their coming home was motivated by other reasons. As has been pointed out, the Balik-Scientists generally perceived a marked improvement in work opportunities in their fields of specialization in the Philippines compared to when they first left. Patriotism seems to be another important factor in their decision to return to the Philippines. This may be seen from their responses to the question: What made you participate in the Balik-Scientist Program? Nine of the 18 Phase II participants indicated they "wanted to help in the development efforts of the country even for only a limited time"; five mentioned that they "wanted to come home right away but did not have transportation money for myself and my family"; two indicated they were curious and "wanted to see changes since I left" or "what qualifications could be marketable in the Philippines."

Views on the Education of Scientists and Engineers

The Balik-Scientists were asked how they would rate their initial education and training obtained in the Philippines in their respective fields of specialization compared with the same level of training that is obtainable in the foreign countries where they resided before returning to the Philippines. It was felt that this question would give

an insight into the relative ease or difficulty of adjustment of Philippine-trained scientists and engineers in foreign work situations and the brain drain problem. This might also give some ideas for reforming the present system of higher education in the Philippines.

Two Phase I participants rated their initial education in the Philippines (occupational therapy and mechanical engineering) as "somewhat superior" and "definitely superior," with that obtainable where they were working in the United States; two thought it was "more or less equal" to their initial education (sugar technology and civil engineering); and two rated it as "somewhat weaker in some aspects" (biological science and chemistry). The participant trained in chemistry thought that the weakness was due to a lack of "experience in the use of some instruments."

Among Phase II respondents, one rated his initial education in the Philippines (geology) as "definitely superior" to what could be obtained where he further trained. Nine thought their Philippine education was "more or less equal" and seven thought it was "somewhat weaker in some aspects" to the same level of training or education that could be obtained abroad. Six specified what they thought were the weaknesses of their undergraduate education. Two mentioned limited library facilities and equipment for research and three felt it was weak in the basic sciences such as chemistry, the biological sciences and statistics.[33] The sixth participant who thought his undergraduate education was weak attributed this to the "practice of spoonfeeding students rather than

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[33]Two of these three had obtained their Bachelor's degree in regional state colleges of agriculture. One majored in agricultural education in his undergraduate course but went on to specialize in animal industries and reproductive physiology for his M.S. and Ph.D. degrees in a U.S. university.

teaching them to be analytical."

The BSP participants were also asked whether they thought the advanced training or education which they obtained abroad can be taken as well in the Philippines. Four of the six Phase I respondents indicated that the advanced training that they got is not available at all and two thought that training opportunities were quite limited in the Philippines. Among the 18 Phase II participants, three (with Ph.D.s in entomology) thought that their advanced training was available in the Philippines "but not of the same quality," three mentioned that training opportunities in their fields were quite limited and four said their "advanced training was not available (locally) at all."[34]

One question posed to the scientists was: Reflecting on your own training and experience, what reforms would you recommend in the curriculum for your field of specialty in order to suit it to Philippine conditions and needs? It was felt that this might yield some useful policy implications. It could also indicate the extent to which the scientists perceived the need for and possibility of making education in science more relevant to the Philippine situation. Four Phase I participants had no suggestions while two recommended giving more training abroad for faculty and technical people. Seven Phase II respondents gave no recommendations. One said he was still feeling his way around and was not sure what was needed. Eleven gave specific recommendations. Six mentioned the need to increase the period required for field work or practice, more relevant laboratory exercises and greater emphasis on local problems. Three felt there was a great need to write textbooks and

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[34]The four who thought their advanced training was not available in the Philippines were in speech communication, educational media, fish management and computer application in geology.

materials for local use as most of the existing ones are foreign in origin and, therefore, examples used were alien to Filipino students. One participant said the government should encourage textbook writing using data obtained from the Philippines. One mentioned the need to introduce more basic sciences, another emphasized the need to improve laboratory and research facilities and a third suggested that people should be sent for advanced training to "countries with identical environmental conditions as the Philippines."

The above data tend to show the Balik-Scientists perceived that the undergraduate curriculum in science and engineering in Philippine schools was relatively up to date compared with that in the United States and Canada where they studied and worked. The ratings of "superior" and "more or less equal to" were much greater than the "weaker in some aspects" rating. Even those who rated their Philippine education as somewhat weak indicated that this was due to the limited library/research facilities and the methodology of instruction rather than to the curriculum itself. The policy implications of their recommendations are quite obvious. Educational planners and policy-makers should provide for more library/research facilities. They should encourage textbook writing among faculty members especially in the state universities and colleges and emphasize more practical problems in curriculum planning. These are necessary to help science and engineering students to orient their future work or graduate studies on problems that are relevant and useful to the Philippines. Thus, whether Filipino scientists will be doing their advanced studies abroad or in the Philippines, the likelihood that they will, in the end remain and work in the country will be greatly increased if not assured.

Implications for the Balik-Scientist Program

The survey results indicate that for a new program, the BSP has been quite successful in achieving some of its professed goals, namely, to "strengthen the academic staff of agricultural colleges and other educational institutions; to strengthen the research capability, increase productivity and upgrade the quality of research programs in the country as they are conducted by private and government research agencies...."[35] That there were fewer than expected applicants for Phase I of the program can be attributed not so much perhaps to the hiya or sense of shame of emigrant scientists and engineers as to the initial lack of publicity of the program. In an interview with the former NSDB Chairman, it was learned that before the BSP was launched, they had requested the Philippine embassies abroad to provide NSDB with information on Filipino scientists residing in their areas, their visa status, employment and the like.[36] He said that such information was needed not only for the start of the program but as continuing information for policy review. The response of the embassies had been poor. This was interpreted as a lack of cooperation with the BSP. It seems more likely that this was due to bureaucratic inertia. The BSP was a new program and with the urgency with which it was formulated and implemented, it is understandable that other parts of the Philippine bureaucracy would lag behind.

Two-thirds (that is 4 Phase I and 12 Phase II) of the participants learned about the BSP from friends or relatives in the Philippines. Five

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[35]"The Spirit of Coming Home," BSP Brochure.

[36]Interview with Brig. Gen. (Ret.) Florencio Medina, Chairman, National Research Council of the Philippines, Metro Manila, 1 April 1977.

Phase II participants learned about it from personal contacts with government agencies such as NSDB, or schools in the Philippines like the U.P. at Los Baños, Visayas State College of Agriculture and others. One Phase I respondent heard about the program from a friend who had earlier been a Phase I participant. Only two (one in each Phase of the BSP) respondents had read about it from newspapers. There is, therefore, a need for improving the publicity of the program both locally and abroad. It may be recalled, from the discussion in Chapter VIII, that even among scientists and educators in the Philippines, there were some who were unable to identify the BSP as an example of a government policy to try to bring home scientists and engineers.

Among Phase II participants, seven indicated that they were going to stay in the Philippines "permanently," "for good," "foreover," and "for life." Four planned to stay "indefinitely"; one said he would remain as long as "I can subsidize my stay here"; another stated he would stay if "I can adjust to the situation here"; and a third indicated that he would stay "five years or more depending on future prospects here and abroad."

Five Phase II respondents thought the BSP offers enough incentives to bring home emigrant Filipino scientists and engineers; nine thought it did not offer enough incentives; and four said they did not know. Five participants mentioned that some of the advertised incentives such as housing, reimbursement expenses and shipping allowances were not actually implemented. Others commented that the BSP cannot really offset the existing motivations for scientists to work abroad. It was their consensus that different individuals have varied values and reasons for staying abroad.

Given these comments, the BSP must ensure the implementation of its publicized incentives and make scientists really feel welcome by facilitating their smooth entry upon arrival through customs and immigration, their adjustment and placement, such as helping to secure a decent housing for the grantee and his family. The BSP should maintain communications or contacts with participants even after they have already been placed in what are perceived to be appropriate positions. In this way, the BSP coordinators can have continuous feedback on the program and will be able to monitor future plans of returning scientists and engineers and their suggestions for strengthening it. A participant highlighted this as a weakness of the BSP. She said that since her arrival, she had not heard at all from the BSP coordinators. She felt that the Balik-Scientists' expertise can be continuously tapped for various government projects as consultants, evaluators, resource persons and the like, in exchange for the privileges that had been given to them.

Summary and Conclusion

The surveys of emigrant Filipino MDs and BSP participants indicate that the desire for further training and the lack of appropriate graduate programs and research facilities in the Philippines were the most important factors which influenced their initial decision to go abroad. Their advanced training abroad exposed them to more modern equipment and facilities for scientific research and professional practice, including greater economic incentives. Since many of the emigrant MDs had unsatisfactory work experiences before leaving the Philippines, their decision to remain in the United States rather than return home after training was logical. As the medical curriculum in the Philippines has been geared largely to Western, hospital-based practice, the MDs had little difficulty finding employment and adjusting to the work situation

in the United States. Most BSP participants surveyed have likewise indicated that the curricula for science and engineering in the Philippines are quite up to date with those in the United States and Canada. Thus, after having advanced training or academic degrees from these countries, BSP participants were similarly able to obtain employment.

The surveys revealed that despite the attractive economic benefits and working conditions abroad, there are MDs, scientists and engineers who intended to go home after their training. However, personal reasons such as the need to earn enough money to pay for transportation and relocation expenses of dependents forced them to work and postpone their return. The longer they had worked abroad, the less likely they would go back to the Philippines. It is this group of highly-trained people that the BSP would be able to attract home.

If one looks at the number of scientists and engineers that the BSP is trying to bring home vis-a-vis the total magnitude of the Philippine brain drain (which was presented in Chapter II), it seems hardly a trickle. However, it has been successful in so far as it has been able to bring home highly-trained scientists. Since most of them now work in the state universities and colleges, they can be expected to have a multiplier effect in providing further training for the country's needed manpower. Moreover, their research activities can be focused towards various development problems. As the data have shown, most of these people can be expected to remain beyond the one year contractual obligation required of Phase II participants.

As the program continues, the BSP coordinators must look more closely into the recruitment of its participants. The program must screen carefully the qualifications of its applicants to get the best and thus insure more returns for government funds spent. It would be

more fruitful if the BSP coordinators could get information on the priority needs for high-level manpower in various educational and governmental institutions. It could then gear its publicity and recruitment efforts towards these identified needs.

The BSP should endeavor to arouse the patriotic sentiments of Filipino scientists, engineers and medical personnel abroad in publicizing its program. This could be done by providing information on Philippine industrial and scientific progress, and the problems and challenges of nation-building in its brochure and advertisements. Parenthetically, patriotism has been an important factor in the return of British scientists from the United States,[37] despite the superior facilities and remuneration the United States had to offer. In deciding to return to Britain, the scientists expressed their preference for the better living conditions at home although they admitted that they were happier with the working conditions in the United States. Patriotism has also been a contributory factor to the successful repatriation of South Korean scientists in the United States.[38] The comments given by educators who had studied abroad and returned voluntarily (which was discussed in Chapter VIII), and those of MDs and BSP participants in the surveys, indicate the positive influence of patriotism in influencing emigrant scientists and professionals to come home. For Philippine educational planners, this suggests that there is a need not only to strengthen courses in the sciences and engineering but also to orient these to the country's problems. The social sciences must necessarily

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[37]James A. Wilson and Jerry Gaston, "Reflux from the 'Brain Drain'," Minerva, Vol. XII, No. 4 (October 1974), pp. 459-468.

[38]Hentges, op. cit., p. 30.

supplement the professional training of scientists, engineers and physicians. These should, therefore, be designed to reflect the dynamics of Philippine development.

The Balik-Scientist Program may not really be able to attract home Filipino scientists and professionals who have become well established abroad. What it can effectively do, as shown by this study, is to help stop the additional loss of highly-trained manpower who are presently needed in the Philippines. This it can do by giving them all the opportunities to learn about career prospects back home and facilitating their initial adjustment to the country's existing conditions. Moreover, there has been an observed reversal of brain drain for European scientists in the United States.[39] This has been attributed to declining growth rates of research and development expenditures by American universities and colleges and cuts in the funding of scientific projects in American industry. If this trend continues, and as news about the progress of Philippine science and industry is disseminated, more Filipino scientists, engineers and other professionals can be expected to want to come home. The BSP can, therefore, through its offer of added incentives, hasten the homecoming of these emigrant Filipinos. In this sense, it can be said that the Balik-Scientist Program is reversing, albeit modestly, the brain drain of Filipino scientists and engineers.

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[39]Thomas P. Southwick, "'Brain Drain': Fewer Scientists Enter the U.S., More Seek to Leave," Science, Vol.169 (7 August 1970), pp. 565-566.

Chapter X

Conclusion

Science Policy is a broad concept. On the one hand, it encompasses measures to foster scientific and technological research and development. These include policies to ensure an adequate supply of qualified scientists and engineers. On the other hand, science policy pertains to the utilization of research results for general political objectives. As such it cuts across many government programs and involves various agencies.

The widespread concern among industrial states with the need for national science policy is quite recent and is largely a post-World War II development. The beginnings of state support for the advancement of science and technology, however, can be traced to the latter part of the eighteenth century. This was initially directed at reforming universities and establishing technical colleges to promote scientific and technological education and stimulate research and development. France and Germany led in this respect. Great Britain followed during the nineteenth century. These reforms were considered vital for industrial modernization and economic progress. Russia's rapid industrialization after the 1917 Revolution demonstrated further the extent to which central planning and direction of scientific research and technological development can be geared towards the achievement of socioeconomic and political purposes. As a consequence of the large-scale mobilization of scientists and engineers during World Wars I and II and the ensuing Cold War, military superiority and national prestige have become important goals of national science policy. Western industrial states have thus established various institutions to plan and implement their science policies.

Concern with national science policy subsequently spread to developing countries, largely through the activities of the United Nations. It has been pointed out in UN-sponsored and other international conferences that dependence or autonomy in science and technology is closely tied up with the political and economic dependence or autonomy of the new states. Modern science developed in the Western cultural, socioeconomic and political milieux and gradually spread to developing states with differing environments, goals and priorities. There is a continuing imbalance between scientific and technological development among contemporary states. Available information indicates that 98 per cent of all research and development facilities are located in developed countries and are almost wholly concerned with the problems of these countries. The remaining two per cent is carried out in developing countries on problems related to their needs.[1] Given this situation, developing states have been exhorted to strengthen their scientific and technological institutions and formulate relevant science policies to support national development plans.

The preceding chapters have examined the Philippine government's science policy since independence in 1946 in respect to scientific education, training and research in fields considered essential to the attainment of its socioeconomic development goals. Scientists, engineers and physicians are regarded as part of the country's vital human resources. They are needed to advance basic or fundamental knowledge about its natural resources and environment, and to innovate in the transfer of technology and utilization of relevant scientific knowledge from other

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[1] Guy B. Gresford and Bertrand H. Chatel, "Science and Technology in the United Nations," World Development, Vol. 2, No. 1 (January 1974), p. 44.

countries. Thus to be of maximum benefit, policies for the education and training of these professionals must be oriented to Philippine society, its present needs and future aspirations.

Findings of the Study

This study began with an examination of the problem of unemployment and underemployment of scientists and engineers in the Philippines, and also with their emigration to other countries. Available information indicated that there was unemployment among graduates in the medical, natural and physical sciences and engineering in the Philippines but up-to-date data on the exact extent of the problem is lacking.

Among employed scientists and engineers, evidence pointed to the existence of misdirected employment, that is, a mismatch between educational preparation and type of work or occupation actually held. In past surveys, instances were found where persons with college degrees in scientific and technological fields held jobs in the national government which were not related to their training and where engineering graduates worked in private industry as draftsmen and technicians. These surveys suggested that there was also a problem of underemployment in the sense that scientific and technological training was either not being utilized at all, or was underutilized.

The precise extent of misdirected employment and underemployment, like that of unemployment, was difficult to ascertain. Nevertheless, these were considered symptoms of an overproduction and maldistribution of scientists and engineers in the country. Census data in 1970 showed that almost three quarters (72 per cent) of the population with college degrees were in urban areas. Philippine urban population in that year was slightly over a quarter (27.6 per cent). The proportion of graduates

in the sciences and engineering in urban areas (about four fifths) was even higher than for all degree holders. Three fifths of agriculture graduates were also in urban areas. At the same time, there were indications that in some regions these professions were in short supply. Published evidence of maldistribution of scientists and engineers tended to be supported by information gathered from interviews I made with educators in colleges and universities in different regions of the country.

The unemployment and underemployment of scientists and engineers has been regarded as a major reason for their emigration to other countries, chiefly to the United States and Canada. Statistics showed that the number of Filipino scientists and engineers entering the United States has increased greatly since 1967. Viewed as a proportion of the total stock of the professions in the Philippines, the brain drain does not seem large. However, as a proportion of the increment to the stock of professions in a given year, the loss of these trained people is sizable. Registered professionals represent the cream of the graduates as evidenced by their success in passing the professional board examinations. It was estimated that the emigration of these persons to the United States in 1971 and 1972 cost the Philippines US$98.8 million in educational expenses. These persons represented US$266.6 million in educational savings to the United States, which was 51.2 per cent more than its economic aid to the Philippines for the same period. The brain drain has thus been labeled a "reverse foreign aid" or "reverse transfer of technology." What is even more critical is the possible loss of key individuals needed in the development process.

Unemployment and underemployment of scientists and engineers were initially thought of as consequences of government policies (or the

absence of them) for the education and training of manpower. In this context, government policies are regarded as independent variables. Government policies are at the same time dependent variables, that is, they are 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 society. With these perspectives, this study examined the structures and processes of policy-making for the education of scientists, engineers and physicians; the nature of professional organizations and the role they played in the education of their members and in the formulation of relevant government policies; the employment of trained manpower in the Philippines; policy-making and implementation for science and technology and the views of government science administrators, educators, professional scientists, engineers and physicians.

The study inevitably involved some digression into Philippine history since Western science and professional education were transplanted in the archipelago by the colonial powers. The need to combat disease, improve agriculture and develop local industry stimulated early scientific research by the Spanish colonists. In the latter half of the nineteenth century, the University of Santo Tomas began to provide for the training of physicians and pharmacists. Nevertheless, the dominance of the religious orders in Spanish colonial politics precluded the development of an indigenous Philippine science and the spread of higher education. The priesthood and law remained the principal professions during the Spanish regime. Scientific research received little government support and thus remained rudimentary.

Much of the present structure of science education and training took

shape during the American colonial regime from 1898 to 1946. The colonial authorities initially adopted a coordinated policy for the promotion of higher education in the sciences and engineering with the establishment of a state university, government research institutions and agencies performing technical functions. Before 1910 a large number of Filipinos were sent to American colleges and universities on government scholarships to obtain higher education in the sciences and engineering. Recipients of these grants were employed in the colonial bureaucracy upon their return. In 1908, the University of the Philippines was established to provide professional training in various fields. Government scholarships were provided to attract students to enroll in medicine, agriculture, veterinary medicine, engineering and other needed professions. Many of the graduates found employment in the Philippine General Hospital, the Bureaus of Science, Health, Public Works, and other government agencies.

Government resources during the American regime were concentrated on the establishment of an extensive public school system, with free primary education. A number of public intermediate, secondary, vocational/technical and normal schools were likewise organized. Science and technical subjects were introduced into the school system but the principal goal of colonial educational policy was to promote universal literacy among the local population. As the number of elementary school graduates grew, the social demand for higher education increased. Since there was only one state university, this demand had to be met by the private sector. Consequently, private sectarian and nonsectarian colleges and universities became common.

The colonial government initially regulated these private institutions through the corporation law, treating them as business enterprises.

Only much later did it deal with them as educational institutions. Over the years, the number of private colleges and universities grew and necessitated closer government supervision, particularly after the 1925 Monroe Survey of Education which found many deficiencies in standards. With the expansion of universities and colleges and the growth of a collegiate population, the choice of degree programs was left to individual preference. The close coordination between higher education and employment opportunities which characterized the first decade of American rule was no longer practicable.

Educational and science policy during the American regime was not coordinated with colonial economic policy. While Filipinos were provided opportunities for higher education in the sciences and engineering, the economy remained basically agricultural. To a great extent, Philippine economic development was determined by free trade relations established in 1909 between the Philippines and the United States,[2] and these continued long after independence was achieved in 1946.[3] As a result of this policy, the Philippine economy became tied to that of the United States, remaining primarily an exporter of agricultural crops and raw materials

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[2]On the consequences of free trade relations on Philippine social, economic and political structures, see Renato Constantino, The Philippines: A Past Revisited (Quezon City: Tala Publishing Services, 1975), especially pp. 296-307.

[3]Under the Philippine Trade Relations Act passed by the United States Congress in 1946, free trade relations continued until 1954, after which it was gradually dismantled by decreasing duty free quotas and increasing tariff duties, ending in 1974. See Teodoro A. Agoncillo, A Short History of the Philippines ("Mentor Book"; New York: The New American Library, 1969), pp. 253-255.

and an importer of American manufactured goods.[4] Undoubtedly, this delayed Philippine industrialization.[5] The relative underdevelopment of the physical sciences vis-a-vis the medical and agricultural sciences may be traced to this policy. Basic and applied research in the medical, agricultural and related sciences received much greater government support during the American regime than did industrial research.[6]

The pattern of relationship between the public and private sectors in higher education which developed during the American regime has persisted in the Philippines. State support for education continues to be concentrated at the elementary school level with state colleges and universities accounting for only 11.3 per cent of total collegiate enrollment in 1972. Private colleges and universities provide education for the majority of the collegiate population which is a small minority of all Filipinos.

The number of state universities and colleges has been increasing since 1946. However, their growth has not been based on a rational plan.

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[4]For an extensive analysis of economic problems arising from this setup, see Shirley Jenkins, American Economic Policy Toward the Philippines (Stanford, Calif.: Stanford University Press, 1953).

[5]Whether intended or not, American consumer values and tastes were also disseminated in the Philippine public school system through the use of American textbooks and materials. With the spread of the mass media, these have become firmly rooted in the Philippines. This may be regarded as "cultural imperialism," and needs further research. See, for example, Martin Carnoy, Education as Cultural Imperialism (New York: David Mckay Co., Inc., 1974), especially chapters 1-2. For a nationalist interpretation of American educational policy in the Philippines, see Renato Constantino, The Filipinos in the Philippines and Other Essays (Manila: Malaya Books, 1966), pp. 39-80.

[6]This may be discerned from the progress reports of the various disciplines in the National Research Council of the Philippine Islands, Annual Report, 1934-35 (Manila: February 1935). The NRCP's 114 chartered members included two physicists, one mathematician, two industrial chemists and seven engineers. The rest were in the medical, agricultural, biological and related sciences. See ibid., Bulletin No. 7.

Partisan political considerations often determined the creation, location and staffing of these institutions. Hence, many of them were ill-equipped and ill-prepared to provide quality higher education particularly in the sciences and engineering. State universities and colleges vary in standards arising largely from the uneven distribution of resources for physical and research facilities, salaries and faculty development programs. The University of the Philippines System remains the most developed with extensive graduate and undergraduate degree programs in the sciences and engineering. It receives over half of the national budget for state universities and colleges.

Private universities and colleges similarly vary in standards. Most nonsectarian universities and colleges are organized and managed like business enterprises and are heavily dependent on tuition fees. To operate profitably, they tend to concentrate on low-cost courses like business administration, liberal arts and education, and encourage large enrollments in these. Sectarian universities and colleges tend to be financially better endowed. Hence, they have been able to impose selective admissions, lower faculty-student ratios and provide laboratory and library facilities required for science and engineering programs. The large number of private colleges and universities to be supervised and the limited Department of Education and Culture (DEC) staff to do it has hampered effective government supervision and control of their standards.

The number of college students and graduates from public and private universities and colleges has shown tremendous increases since 1946. Nevertheless, the proportion of those in agriculture, medical and natural sciences,and engineering has remained relatively low. There are very few graduates in the physical sciences. Most students (and graduates) in agri-

culture come from state institutions while most of those in engineering and medical sciences come from private institutions. In both, the majority of college students and graduates continue to be in teacher training/education and commerce/business administration courses. This situation results from the fact that students tend to enroll in courses where there are perceived employment opportunities and which their families can afford. Engineering and science courses entail longer periods of study and have generally been more expensive to pursue.

It was apparent from my research that the absence of a national education plan related to national and economic development plans resulted in the lopsided production of graduates. There were relatively few graduates in sciences, engineering and medicine. Yet many still faced unemployment or underemployment. This fact and the dearth of facilities and scholarship grants for graduate studies in these fields in the Philippines may have led many professionals to go abroad for further studies and subsequently decide to emigrate. This perception was supported by the results of my interviews and questionnaire surveys of science administrators, educators, immigrant Filipino physicians in the United States and participants in the Balik-Scientist Program.

The Report of the 1969 Presidential Commission to Survey Philippine Education (PCSPE) pointed to the consequences of the lack of rational planning and policy-making for education in relation to national development goals. These were the overproduction of college graduates in certain courses relative to the needs of the country, the lack of graduates in the sciences, the low standards of many institutions and thus a wastage of human and material resources. PCSPE presented a number of policy recommendations to improve the quality of college education in the country

and attract more students to enroll in agriculture, the sciences, engineering and technology. Some of these recommendations such as, for example, a national college entrance examination and educational development projects in agriculture and engineering are now being implemented by the Department of Education and Culture.

The rise of professional organizations of scientists and engineers followed closely the growth of higher education in the Philippines. The earliest organizations were in medicine and pharmacy, professions which were the first to be introduced during the colonial era. As the number of graduates in a particular discipline increased, associations were formed to promote professional interests and regulate standards of practice and these were modelled after their counterparts in the United States. Self-regulation by professional associations was eventually institutionalized in government laws which established professional examining boards and licensing procedures.

In certain cases, professional organizations initiated changes in the collegiate curriculum for their specialization and worked for improvements in educational standards. The Philippine Medical Association (PMA) actively worked to improve standards of medical education by limiting enrollment in medical colleges and adding courses required for the medical degree. Academic members of the profession have led in questioning the relevance of Western-oriented medical curriculum to Philippine conditions. This has resulted in recent innovations in medical training such as more exposure of students to community medicine and the experimental curriculum to produce doctors for rural areas. In the field of engineering, the Philippine Institute of Chemical Engineers initiated a series of conferences to discuss curriculum revisions for its profession. Results of

these conferences were then endorsed to the Department of Education and Culture for official adoption. In other branches of engineering, the government through DEC convened meetings of educators, members of professional examining boards, representatives of professional organizations and the private sector to update and adopt uniform core curricula for all universities and colleges to follow. These developments took place in 1973-74.

The effectiveness of professional organizations has been hampered by rival factions (and sometimes by competing associations) formed by government employed and privately employed or practising members and the leadership in most professional associations has tended to come from the government employed, Manila-based members. This pattern seems to be changing as privately employed or practising members have been elected as officers of the PMA and other associations. Professional organizations have also been forced to integrate for licensing purposes by the Professional Regulation Commission.

As the professions developed stable organizations and expanded membership, they influenced government policies affecting their practice such as, for example, adoption of regulatory laws and establishment of relevant government programs. The creation of the Philippine Medical Care Commission and the establishment of the medical care program was sponsored by PMA. The Philippine Society of Sanitary Engineers worked for the creation of the National Pollution Control Commission and adoption of pollution control legislation. In most cases, however, the creation of government science agencies and formulation of broad science policies were initiated by multidisciplinary associations particularly the Philippine Association for the Advancement of Science (PhilAAS). PhilAAS leadership

has been largely dominated by government scientists.

The underlying pattern of education and training of scientists, engineers and physicians established during the American regime remained unchanged long after independence in 1946. This is in part due to the conservative nature of self-regulation by the professional associations. Because of specialized training, vertical organization by disciplines and lack of liaison between professions, professional associations have been unable to perceive the dynamic relationship between science, technology and society and the relevance of their training to Philippine conditions. With the government's emphasis on development planning, its avowed goal to build the New Society and the establishment of the Professional Regulation Commission, professional associations have, since 1973, focused more attention on their role in Philippine society.

Information on scientific and technological manpower in the Philippines is often out of date. This has hampered attempts at education and manpower development planning. Available data from 1965 to 1967 showed that the majority of the scientists and engineers, particularly in the fields of engineering, physics and chemistry, were employed by industry. Most of these were in manufacturing. Very few were engaged in research and development. This situation may be attributed to the dependence of large corporations on foreign science and technology and the dominance of multinational corporations. Most government scientists were engaged in applied research and development, management and administration. Most academic scientists were occupied mainly in teaching. Few were doing research exclusively or combining teaching and research. To a large extent, this tended to reflect the dominance of the private universities and colleges. Teaching hours tend to be longer in these institutions and class sizes larger. Thus scien-

tists have limited opportunities or incentives for research. The bulk of academic research is done by scientists and engineers in state universities and colleges.

There were indications of shortages of qualified scientists and engineers, particularly in physics, mathematics and the biological sciences. The expansion of state universities and colleges and of government research and technical agencies, and the growth of industry are likely to increase the need for these professions. This perception tended to be supported by results of interviews I had with science administrators and educators. In the competition between sectors for the available supply of highly-trained manpower, universities and colleges, particularly the private ones and those located in the regions, are likely to suffer because of the lower salary scales and heavier work load attached to academic positions. This would create a vicious circle with respect to the problem of developing quality education in the Philippines. As universities and colleges are depleted of their highly-trained scientists and engineers their standards are likely to be weakened further.

The National Science Development Board (NSDB) was organized in 1958 as the agency charged with the formulation of policies and programs to promote the advancement of science and technology. Among several functions entrusted to it was the development of a national program for the effective training and utilization of scientific and technological manpower. NSDB has not been able to perform this function effectively for several reasons. First, the power to formulate education and science policies ultimately rested with the old Congress. State universities and colleges were created by Congress and partisan political considerations rather than rational criteria often underlay their establishment.

Second, universities and colleges determined their curricula in science and engineering subject to policies, rules and regulations laid down by the Department of Education and Culture, while professional licensing and regulation was governed by various examining boards. NSDB does not have linkages with these boards and until 1973 was not even represented on the National Board of Education of DEC which was responsible for preparing national education plans and policies. Third, NSDB lacks up-to-date information about the supply of or demand for scientists and engineers, about their employment patterns and future needs for these manpower. Fourth, NSDB's operations have been hampered by lack of funds. Its scholarship programs have had a limited influence on the supply of highly-trained scientists and engineers. Finally, NSDB has limited authority to coordinate agencies performing scientific and technological functions as some are not integral part of its organization.

For the most part, policies concerning higher education, scientific research and economic development were adopted in the past without much consideration as to their interrelation. National economic development plans and programs prepared by past administrations were never fully adopted by the old Congress. Since Martial Law in September 1972, there has been closer coordination between national development planning and policy-making. Moreover, under the present administration, the role of science and technology in development programs has been given more consideration. In the Four Year Development Plan, FY 1974-1977, a national science development program has been articulated with education and manpower development and other sectoral programs.

The reorganization of NSDB's Board of Governors and the National Board of Education in 1973 reflects the desire of the government to sys-

tematize and integrate programs for higher education with the advancement of science and technology in the context of national economic and development plans. NSDB's Board of Governors now include the Director General of NEDA and DEC Secretary as members and the NBE's membership now includes the Chairman of NSDB.

NSDB's research policy has consistently put highest priority on applied research and development. It has implemented this through grants-in-aid to individual scientists, universities, colleges, government research agencies and the private sector. NSDB's priority areas for research (such as, for example, increased food production, improved nutrition, rural development, energy development and the like), reflect the government's priorities in national development plans and thus are directly relevant to the country's needs and conditions.

The largest part of NSDB's research funds have gone to a few well developed universities, especially the University of the Philippines System. This reflects the fact that these institutions have had most of the highly qualified scientists and better research facilities. In some countries, part of a scientist's research grant goes to support graduate students. This has not been the case in the Philippines. There seemed to be little if any direct connection between grants-in-aid for research to scientists in universities and the education and training of younger scientists for careers in the sciences and engineering. The scale of scientific activities funded by NSDB was mainly "little science" rather than sophisticated, "big science".[7] This was largely due to the limited

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[7] See Derek de Solla Price, Little Science, Big Science (New York: Columbia University Press, 1963), especially pp. 1-14.

resources for science.

Scientists proposed research projects to NSDB which were then evaluated and funded according to established research priorities. NSDB does not have any regular mechanism for determining existing research gaps in these priority areas. In comparison, the Philippine Council for Agriculture and Resources Research (PCARR) has identified not only broad research priorities in agriculture and natural resources but also adopted a mechanism for identifying specific problems requiring studies in these priority areas. PCARR's research priorities are also closely linked with those of its manpower development programs. There is thus greater coordination between funding of agriculture and resources research and programs for the education and training of needed scientists. To a certain extent, PCARR has been able to develop more systematic planning, programming and monitoring of research and development activities and manpower development because of its more specific area of concern. NSDB's responsibility broadly encompasses the sciences and engineering.

NSDB has been able to work for the creation of new research agencies such as the Philippine Textile Research Institute, the Philippine Inventors Commission, and the Forest Products Research and Industries Development Commission, which are now among its organic agencies, and the Metals Industries Research and Development Center which is now an attached agency. NSDB has six organic agencies under its supervision and control and five agencies are attached to it for policy coordination. There are also science agencies outside NSDB's coordination, for example, the Philippine Atomic Energy Commission and the National Pollution Control Commission. NSDB's direct influence over these agencies exists only insofar as they become recipients of research grants coming from the Special Science Fund.

NSDB administrators have been mainly scientists with undergraduate degrees from the University of the Philippines and further training from foreign, mostly American universities and research institutions. They have all served in various government positions before being appointed to NSDB. Their scientific education enabled them to recognize the need to make science and engineering education and research relevant to the country's needs and conditions. They were, however, unable to effectively operationalize their visions of what Philippine science should be. There seem to be a number of reasons for this. First, the development of scientific activities and programs of the government was not planned as a whole but evolved in accordance with specific missions of departments and agencies. Second, past decision-making on economic policies involved officials whose professional training was in law, economics and some other social science. Scientists tended to be excluded from these deliberations. Hence, the possible consequences of these policies on the long-term development of Philippine science and technology and implications for higher education policy were not considered from a strictly scientific point of view. Third, NSDB administrators inherited the traditional bureaucratic structure with its emphasis on seniority, the lack of proper civil service classification of scientific and technological personnel, and rigid auditing rules and procedures. These hampered the recruitment of young but highly qualified scientists to higher positions and also made science agencies vulnerable to political patronage. Consequently, NSDB and its agencies failed to attract the best graduates in science and engineering. Finally, NSDB administrators to some extent were handicapped by their lack of training in policy-making, management and administration.

The interviews provided much insight into issues on the education and

training of scientists and engineers. Interviews with educators in various universities and colleges tended to substantiate findings of previous studies of higher education and the brain drain. Universities and colleges had varying standards and encountered problems in attracting and retaining qualified faculty in the sciences and engineering. There was a general tendency for better qualified staff to transfer to established universities or industry in the Metropolitan Manila Area or to emigrate to the United States or to other countries. This fact, and financial constraints, were frequently encountered problems in putting up quality programs in agriculture, other sciences and engineering, especially in the regions. There was a general feeling among private universities and colleges in the regions that they were often ignored in the process of policy-making for higher education in their areas. Some scientists felt that there should be some way of distributing NSDB funds so that they would not go all the time to the same universities, but would aid in the development of regional universities and colleges.

The educators interviewed tended to be optimistic about present job opportunities for science and engineering graduates and about future employment trends. They considered the education and training of scientists and engineers to be relevant and adequate for Philippine needs. They were aware that most textbooks and materials in science and engineering were foreign but believed they could be adapted to local needs by using research results from the University of the Philippines, NSDB and their own local projects. However, they felt that domestic textbook writing should receive more government encouragement and support than it does. There was a general feeling among the interviewees that the government should provide more incentives and rewards for scientists and engineers who have remained in the country rather than to try to attract home

those who voluntarily left. They reasoned that scientists and engineers who left the country had different values and motivations from those who remained.

The survey of Filipino physicians and medical scientists who had emigrated to the United States tended to confirm some of the findings of previous studies of the brain drain. The emigrants generally left to obtain specialized training which was not available in the Philippines. In the course of their training abroad they were exposed to better employment opportunities in terms of superior facilities and economic rewards. Hence, they decided to remain in the United States rather than return home after training. Some who went home after their training eventually decided to return to the United States. Lack of professional satisfaction and poor economic rewards in the Philippines were frequently cited as reasons. The survey results tended to show that Filipino MDs easily adjusted to their work situation in the United States. This may be attributed to the fact that the medical curriculum in the Philippines is heavily oriented towards American, hospital-based practice. Although many respondents perceived that there had been some economic progress in the Philippines and increased opportunities for professional practice since they left, few were willing to return permanently and many were skeptical about the effectiveness of government policies to attract them home.

The survey of initial participants in the Balik-Scientist Program (BSP) showed that scientists and engineers generally left the country to obtain higher education and training abroad. Financial difficulties often forced them to work after completing their training. The longer they worked abroad, the greater the likelihood that they would stay there

permanently. The Balik-Scientist Program provided an opportunity for them to return immediately to the Philippines, but the number of returning scientists under BSP sponsorship was mere trickle when set against the magnitude of the brain drain as a whole. However, the fact that most were employed in state universities and colleges provided sufficient justification for government funds to be expended for the program. For the employing institutions, the BSP not only served to supplement their staff development program but also cut the time lag involved in developing their faculty.

The surveys of educators, immigrant Filipino MDs and BSP participants suggested that patriotism is an important motivation for those highly-trained scientists who do return, and remain, in the Philippines despite the attraction of higher economic rewards and superior facilities for science and engineering research elsewhere.

Towards an Independent Scientific Tradition

The findings of this study suggest that the Philippine government has been undertaking the necessary tasks that would facilitate the development of a colonial, dependent science into an independent, indigenous scientific tradition.[8] These include providing for the teaching of science at all levels of the educational system; positive encouragement and government financing of scientific research and development activities; focusing on the important role of scientists and engineers in Philippine

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[8]For this concept of scientific development and the necessary tasks involved, see George Basalla, "The Spread of Western Science," in Sal P. Restivo and Christopher K. Vanderpool, eds., Comparative Studies in Science and Society (Columbus, Ohio: Charles E. Merrill Publishing Co., 1974), especially pp. 366-375.

development; giving encouragement to professional scientific organizations; promoting national and international scientific communication; and adopting policies to foster industrial and technological development. The education and training of scientists and engineers and their proper utilization underlie the effectiveness of all these efforts to develop Philippine science, one that is oriented to the conditions, needs and aspirations of Philippine society. Nevertheless, there are certain further steps that must be taken to hasten this development.

There is a need for more accurate, up-to-date information on the supply of scientists, engineers and physicians in the Philippines, their fields of specialization, level of education, employment by sector and functions they perform, salary levels, regional distribution, and projected requirements for these trained people. This requires systematic collection and continuous monitoring of data and can be implemented by interdepartmental collaboration involving NSDB, NEDA, National Census and Statistics Office, Departments of Education and Culture, Health, and Labor, and the Professional Regulation Commission. NSDB should formulate the conceptual framework for the collection of the data including standard definitions of qualified scientists and engineers, their classification by fields of specialization, categories for scientific and technical functions and the like. This would eliminate many of the discrepancies in statistics coming from different departments and agencies and expedite their collation and analysis. Such information is basic to any systematic planning of manpower development and the proper allocation of scarce government resources, for example, the state scholarship program under DEC, NSDB's science scholarships and others. The data would provide guidance for college students in the choice of courses to pursue and also

expedite proper placement of graduates.

The resources of the professional associations should be tapped to assist in maintaining up-to-date information on manpower supply and demand. NSDB and its regional offices should establish linkages with these organizations for this purpose. The project to set up a Center for Scientific and Technological Organizations in the NSDB science complex should be revived to institutionalize NSDB's relations with professional associations.[9]

NSDB should be authorized to formulate,in consultation with the Civil Service Commission and the Office of Compensation and Position Classification,a classification of government positions with scientific and technological functions. This would standardize qualifications and salaries for similar positions in research and technical agencies, regular departments, bureaus, offices and government corporations.[10] Civil service eligibilities are now being granted to scientists and technologists whose fields of specialization are not covered by professional board examinations. NSDB has been involved in implementing this recently adopted policy. Hence, a more systematic position classification is necessary to promote scientific careers in government and minimize the staffing problems encountered by past science administrators because of political patronage. In this regard, consideration should be given to the possibility of making parallel career opportunities for scientist administrators and

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[9]Details of this project were discussed in Chapter VI, pp.296-298.

[10]Great Britain's classification of its scientific civil service may provide some ideas for this proposal. See J. W. Grove, Government and Industry in Britain (London: Longmans, Green and Co., Ltd., 1962), p. 282.

scientist-researchers to encourage creativity in the production and utilization of scientific knowledge.[11]

There is a need to strengthen the capability of higher educational institutions to provide quality education for scientists and engineers needed by the country. NSDB can undertake several functions towards the attainment of this goal. To support the government's efforts at regional development and help minimize the maldistribution of scientific and technological manpower in the Philippines, NSDB should cooperate with DEC in assisting universities and colleges to form consortia to provide the quality science degree programs that are needed in their respective regions. This would seem to be a more effective alternative than the creation of additional state colleges or universities and would help to develop more uniform academic standards between public and private institutions. DEC's role would be to clarify for participating institutions the sharing of authority and responsibility for granting degrees, admissions standards and other requirements. NSDB would provide grants to maximize the use of laboratory and other physical facilities, faculty resources and the like.

To help upgrade standards in the sciences and engineering among public and private universities and colleges, NSDB should encourage, through some form of matching financial grants, sabbaticals of qualified professors in interested institutions especially in the regional areas. This is already being done in certain cases at the University of the Philippines, with sabbaticals usually spent in foreign universities. NSDB sponsored

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[11]This had been suggested in the past by several scientists. See, for example, Geminiano de Ocampo, "Research and Medical Education," U.P. Research Digest, Vol. I, No. 3 (July 1962), pp. 21-23; Jose R. Velasco, "The Status of Science in the Philippines," U.P. Research Digest, Vol. VI, No. 1 (July 1966), pp. 2-6; Narciso Cordero, "Some Factors Affecting Research in the Basic Medical Sciences," ibid., pp. 7-11.

sabbaticals should be geared to Philippine institutions. Even junior faculty may be involved in cases where their expertise may be critically needed in any area in the country.

NSDB should make available teaching/research fellowships for junior faculty and research staff, especially in newly established state universities, to provide for staff development in much needed fields like mathematics, physics and the biological sciences. Moreover, research awards may be made tenable in the different regions to encourage faculty/staff interchange and communication among universities and colleges.

In accordance with the government's requirement of rural or community services for 15 days each year from all its employees, those for faculty/staff of state universities and colleges may be tied to regional education programs such as curriculum development, research and development, and others. Such a program should be done on a continuing basis. Rural service for government scientists may likewise be directed to this program.

NSDB should expedite the establishment of a Center or Institute for Advanced Studies to provide graduate education in physics, mathematics and other needed disciplines.[12] This would minimize the need to send Filipinos abroad for further studies and thus limit the channels for brain drain. The Institute would be set up by pooling qualified faculty who are presently dispersed in several institutions, mostly in the Metropolitan Manila Area. The proposed NSDB-funded sabbaticals for qualified professors in the regions could be geared further to the staffing needs of this Center or Institute. To ensure that faculty and graduates

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[12] As mentioned in Chapter VI, p.304, this was previously recommended in 1972 by the Senate Committee on Education, Higher Education Research Council and in 1977 by a Workshop group in the NSDB Seminar-Workshop on Science Policy.

of the new Institute are kept abreast of developments in their fields, NSDB can explore possible postdoctoral fellowships in other countries for periods of six months to one year and bring in foreign scientists as teaching/research fellows for short periods.

The Balik-Scientist Program's campaign to bring home emigrant scientists and engineers should be redirected to support the need for staff development among regional universities and colleges and provide visiting faculty or research fellows for the proposed Institute or Center for Advanced Studies. Instead of the two-week invitational period for Phase I participants, NSDB should provide for semestral or one year visiting lecture or research fellowships for emigrant scientists and engineers in needed disciplines. This may require cutting down the number of existing slots for Phase I participants but would result in greater long run benefits for both visiting scientists and host institutions in terms of the advancement of higher education in science and technology in the Philippines.

NSDB should continue its support for regional science high schools, training programs for elementary and high school science teachers, the UP Science Education Center and projects such as textbook writing and upgrading of laboratory science equipment for elementary and secondary schools.

All these proposals for strengthening the education and training of scientists and engineers must be carried out in the context of the recommendation of the Presidential Commission to Survey Philippine Education (PCSPE) in 1970 that: "The educational goals which are presently heavily oriented to individual development should be reformulated to give primacy

to community and national development oriented goals."[13] Hence, science and technology must be viewed not just a system of organized knowledge, methodology and techniques to be transmitted through specialized programs in educational institutions but as a "cultural process"[14] that must be adapted and integrated in the Philippine milieu. There is thus a need to provide some confluence between professional/technical courses and social science and humanities courses required in degree programs for scientists, engineers and physicians. This may take the form of subjects focusing on the development of science and technology in relation to society and culture in general, on the distinctive features of this development in the Philippines, and on the possible application of science and technology for the improvement of the quality of life in the country. These proposed subjects would be more useful than the Spanish language courses presently required of all college students.

There is a need for closer integration of science policy making and national economic and development planning. This was recommended by Synergistic Consultants, Inc. (SCI) in its science policy study for NSDB in 1977.[15] SCI emphasized the mission-oriented character of science and technology development, the need for science and technology programs to be geared towards the solution of the country's pressing problems, to be planned and coordinated as a total system. SCI thus proposed that NSDB be restructured into a Science and Technology Development Authority, to

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[13] PCSPE, Special Area Group on Higher Education, A Report on Higher Education in the Philippines (Manila:1970, mimeo.), p. 64.

[14] For this concept of science, see Maurice N. Richter, Jr., Science as a Cultural Process (Cambridge, Mass.:Schenkman Publishing Co., Inc., 1972), especially pp. 33-61.

[15] Synergistic Consultants, Inc., Science Policy Studies; Final Report (Manila: March 1977, mimeo.), p. 31.

function like PCARR, with power to define major thrusts in terms of R & D missions and allocate funds to research councils.[16] SCI also recommended the creation of new research councils, similar to PCARR or the Energy Development Board which would have jurisdiction in various areas of concern.

This study supports SCI's recommendation that NSDB needs to be strengthened but differs in its proposals towards this goal. As shown in Chapter VI, the problem of NSDB is its limited authority and its lack of coordination with other technical agencies/offices whose areas of concern overlap with some of NSDB's. What is needed, therefore, is not a proliferation of new research councils or a restructuring of NSDB along the lines recommended by SCI but a reexamination of existing councils and agencies for the purpose of redefining their areas of concern, functions and powers and delineating their relations with NSDB. In this connection, there should be a management review not only of NSDB's central office, such as SCI undertook in 1977,[17] but also of its organic and attached agencies.

Proposed plans, policies and legislation involving the transfer of technology and other measures which have implications for the development of Philippine science and technology should be referred to NSDB for its comments and advice. This would provide for better coordination of science policy and national development planning. For purposes of consultation and policy advice, NSDB should establish and maintain liaison with professional

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[16] Ibid., p. 32, chapters 3-4.

[17] See Synergistic Consultants, Inc., Management Review of the National Science Development Board (Central Office); Final Report and Addendum to Final Report (Quezon City: Center for Development Studies, Inc., 1977, mimeo.).

scientific and technological associations and the private sector.

To promote more responsive and effective management and administration of NSDB and other scientific and technical agencies, there is a need to develop a class of scientist-administrators.[18] Scientists in administrative positions should be given some training in public policy and administration at a certain stage of their career, possibly even earlier than those being given by the Development Academy of the Philippines for the career executive officer class. Similarly, civil servants in science and technical agencies such as, for example, administrative, budget and supply officers and auditors and their counterparts in the Budget Commission and Commission on Audit should have some understanding of the nature of scientific and technological research, attitudes of scientists and the problems encountered in these programs or projects. This does not necessarily mean that civil servants in these positions should have science and engineering degrees, but they should undergo some in-service training for this purpose. Such training program may be developed by NSDB in cooperation with the Civil Service Commission, scientists at the University of the Philippines or other institutions.

Science for the People

The underlying perspective of this study has been that science and technology can be planned. It is a view that has become widely accepted.[19]

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[18] The concept was suggested by Grove, op. cit., p. 281.

[19] See, for example, Harvey Brooks, "Can Science Be Planned?" in OECD, Problems of Science Policy; Report of Seminar Held at Jouy-en-Josas, February 1967 (Paris: OECD, 1968), pp. 97-112.

Science and technology can be directed towards the conditions and needs of a given society. The continuing problem in the Philippines is how to popularize science and technology as part of its culture and to attract the best students to pursue careers in these fields. Moreover, there is a need to search for science and technology that is appropriate to Philippine society. As an economist pointed out:

> The economics of permanence implies a profound reorientation of science and technology, which have to open their doors to wisdom, in fact, have to incorporate wisdom into their very structure. Scientific or technological 'solutions' which poison the environment or degrade the social structure and man himself are of no benefit, no matter how brilliantly conceived or how great their superficial attraction. Ever bigger machines, entailing ever bigger concentrations of economic power and exerting ever greater violence against the environment, do not represent progress. They are a denial of wisdom. Wisdom demands a new orientation of science and technology towards the organic, the gentle, the nonviolent, the elegant and the beautiful.[20]

This implies the need to focus not only on the upgrading of science and technology courses but also the strengthening of the social sciences and humanities, for

> What is at fault is not specialization, but the lack of depth with which the subjects are usually presented and the absence of metaphysical awareness. The sciences are being taught without any awareness of the presuppositions of science, of the meaning and significance of scientific laws and of the place occupied by the natural sciences within the whole cosmos of human thought. The result is that the presuppositions of science are normally mistaken for its findings.[21]

The problem of developing science and technology for the people is not unique to the Philippines. Moreover, the search for solutions must

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[20] E.F. Schumacher, Small is Beautiful; A Study of Economics as if People Mattered (London: Abacus, 1974), pp. 31-32.

[21] Ibid., pp.91-92.

take into account the values and peculiar conditions of the society. The scientists and engineers in the country must be adequately trained in their respective disciplines but must also be made constantly aware that science and technology are not simply ends in themselves but also means for the improvement of the material quality of life. Along with their scientific and technical courses, scientists and engineers must be presented with the challenge of national development -- the problems faced, available resources in the country, and their potential contribution to the attainment of national goals. They must understand that the Philippines cannot match the personal material benefits available to them in developed countries, but that there are other rewards, for example, professional prestige, social esteem, and national pride, which await them at home. Science and education policy-makers have a responsibility to consider how to design courses to present these ideas and integrate them into the existing curricula.

My study has shown that government science agencies have increasingly chosen research and development priorities which are for the benefit of the Filipino people, i.e. increased food production; improvement of nutrition, medicine and health care, housing; development of intermediate, labor-intensive technology; alternative sources of energy; and others.[22]

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[22] A recent government innovation is the establishment of the National Institutes of Biotechnology and Applied Microbiology in the U.P, at Los Baños. The thrusts of these Institutes are to "mobilize and strengthen national competence in the application of microbiology, genetics, chemistry, engineering and related disciplines, among others, on the generation of energy from renewable sources; on improved crop, livestock, fishery and forest production and utilization; in the syntheses of antibiotics, ensymes, hormones, proteins, nutrients and other chemicals from non-fossil carbon sources; and in the enhancement of the environment." See "Biotechnology, Microbiology Institutes Established at U.P. at Los Baños," New Horizons, Vol. I, No. 3 (November/December 1979), pp. 1,2.

These are also areas in which Filipino scientists and engineers can be expected to contribute to the international fund of scientific knowledge as many of these researches are on problems peculiar not only to the Philippines but also to similarly located developing countries. Both targeted basic research and applied research and development need to be undertaken. Given the limited resources which the government has for science and other development programs, emphasis on applied research is understandable. Nevertheless, the necessary basic research should also be encouraged. In medicine and health care, for instance, basic research is needed on local medicinal plants to promote their more effective use by the people and to find alternative raw materials for the Philippine drug industry. This would thus lead to the production of cheaper medicines for the Filipino. As it is, the country is still heavily dependent on imports of these raw materials and, hence, at the mercy of the multinational pharmaceutical firms.[23]

The possibilities of scientific and technological development appropriate to the new states have been amply documented.[24] Recent developments

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[23]See, for example, 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). The NSDB-U.P. at Los Baños medicinal plants project recently received additional funding from a local drug firm. This is an encouraging move for local scientists. See "UPLB's Medicinal Plants Project," UPLB Newsletter, 30 April 1980, p. 4. For a recent critique on policies regarding nutrition, health care and the drug industry, see "Health Care in the Philippines," Philippine Liberation Courier, June 1980, pp. 3-5.

[24]See, for example, Godfrey Boyle and Peter Harper, eds., Radical Technology (New York: Pantheon Books, 1976); R.J. Congdon, ed., Introduction to Appropriate Technology; Toward a Simpler Life-Style (Emmaus, Pa.: Rodale Press, 1977); Vaclav Smil, "Intermediate Energy Technology in China," Bulletin of the Atomic Scientists, Vol. 33, No. 2 (February 1977), pp. 25-31; Andrew Barnett, Leo Pyle and S.K. Subramanian, Biogas Technology in the Third World; a Multidisciplinary Review (Ottawa: International Development Research Centre, 1978); George McRobie, "Intermediate Technology: Small is Successful," Third World Quarterly, Vol. I, No. 2 (April 1979), pp. 71-86; David Spurgeon, ed., Give us the Tools; Science and Technology for Development (Ottawa: International Development Research Centre, 1979), Part Two.

in the international scene -- rising oil prices and the specter of global energy crisis; the controversy over the safety of nuclear power, accelerated by the Three-Mile Island nuclear mishap; the threat of world-wide economic recession; imminent food shortages, population growth and poverty in developing states; the ever-widening gap between the rich and poor countries; persistent economic inequalities in developing countries; to mention some of these -- point to the imperative of scientific and technological autonomy for the Philippines and other developing states. Schumacher had foreseen some of these and pointed to the necessity for reorienting modern science and technology. The massive deployment of science and technology for destructive ends, particularly in the Vietnam War, engendered even more harsh criticisms of contemporary Western science and technology.[25]

Science for the people as used in this study does not mean a rejection of Western science and technology but rather that the Philippines (and other developing states) should be selective in adopting science and technology for their particular needs and conditions. China has learned this from experience.[26] There are, of course, certain obstacles to the

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[25]Some of these criticisms can be seen in Hilary Rose and Steven Rose, eds., The Political Economy of Science; Ideology of/in the Natural Sciences (London & Basingstoke: The Macmillan Press Ltd., 1976) and their The Radicalisation of Science; Ideology of/in the Natural Sciences (London & Basingstoke: The Macmillan Press Ltd., 1976).

[26]See Maurice N. Richter, "Chinese Science Policy; A Comparative Analysis," Bulletin of the Atomic Scientists, Vol. 32, No. 3 (March 1976), pp. 13-16; Richard P. Suttmeier, Research and Revolution; Science Policy and Societal Change in China (Lexington, Mass.: Lexington Books, 1974); Charles Ridley, China's Scientific Policies; Implications for International Cooperation; AEI-Hoover Policy Study 20 (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976); Science and Technology in the People's Republic of China (Paris: OECD, 1977).

development of scientific and technological autonomy which should be further investigated. In the Philippines, one such obstacle is the tendency of economic planners to continue to espouse economic development through industrialization along Western lines following the American model,[27] emphasizing the development of industries for export rather than for internal, basic needs. This contributes to the inegalitarian economic and social structure which Myrdal considers a serious hindrance to reforms to solve problems of underdevelopment.[28]

The dominance of multinational corporations in the Philippines is a consequence of economic policies that have emphasized foreign private investment and industrialization. It is also a symptom of its continuing dependence on the United States and, hence, perpetuates scientific and technological dependence. It has been suggested that these multinationals contribute to the "denationalization" of national elites in that they tend to identify with the interests of the corporations they work for rather than the national interest.[29] To the extent that this is true, then

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[27]See Robert B. Stauffer, "The American Development Model: Hidden Agenda for the Third World," Philippine Journal for Public Administration, Vol. XXI, No 2 (April 1977), pp. 123-140.

[28]Gunnar Myrdal, "Underdevelopment and the Evolutionary Imperative," Third World Quarterly, Vol. I, No. 2 (April 1979), pp. 24-42.

[29]See Robert B. Stauffer, "The Political Economy of Development: A Philippine Note," Philippine Journal of Public Administration, Vol. XVI, No. 2 (April 1972), pp. 129-146. In subsequent writings, Stauffer observed that Martial Law was imposed to protect the interests of multinationals and their allies among the Philippine elite. See his "The Marcos Coup in the Philippines," Monthly Review, Vol. 24, No. 11 (April 1973), pp. 19-27; "The Political Economy of a Coup: Transnational Linkages and Philippine Political Response," paper prepared for the University of Hawaii (Honolulu: n.d., mimeo.); "Philippine Martial Law: The Political Economy of Recolonization," paper presented at a meeting of the Association for Asian Studies, Boston, 3 April 1974, mimeo.

science for the Filipino people would be that much slower to establish. The continuing presence of American military bases in the Philippines is another symptom of its dependent relations with the United States. These bases have been regarded as necessary for the protection of American economic and political interests rather than for those of the Philippines.[30] All these suggest the difficulties of fostering scientific and technological autonomy in a country which relies heavily on external aid for its national development. There is thus a need for administrators and scholars to examine more closely national science and technology policies and how to integrate them with appropriate economic policies in the context of the realities of international relations. Scientific and technological autonomy is desirable and feasible but it requires hard decisions.

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[30] See Claude A. Buss, The United States and the Philippines; Background for Policy; AEI-Hoover Policy Studies 23 (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1977), ch. 3, passim. The bases are also considered by some as support for the established government. See Daniel B. Schirmer, "The Philippine Bases: Bulwark of Dictatorship," The Progressive (April 1978), reprinted by Friends of the Filipino People, Washington, D.C.; "The Bases Agreement--A Commentary," Philippine Liberation Courier, Vol. III, No. 1 (26 January 1979), pp. 4-5.

Appendix A. Socioeconomic Environment of Science

In order to have a better perspective of the goals and problems of science policy, a brief survey of Philippine social and economic conditions is necessary.

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 are Luzon with an area of 40,420 square miles and Mindanao, 36,537 square miles. Only 154 islands are at least five square miles, with 11 of them representing 95 per cent of the national territory. 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. Because of these extensive earth movements over geologic time, mountain ranges developed dividing the archipelago along a general north-south alignment. About 65 per cent of the Philippines are mountainous or upland.

Much of the country also lies within the path of tropical cyclones which vary in severity depending on the maximum wind speed about their centers. The most destructive are the typhoons which have center wind velocities of more than 118 kilometers per hour. The frequency of typhoons increases generally from south to north. Only southern Mindanao is relatively free of their havoc. More than half of these typhoons

usually occur from June to October.[1] 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 is about 120 inches, ranging from 35 to 216 inches in different parts. The average temperature for the archipelago is 26 to 28 degrees centigrade.

The natural resources of the Philippines consist of agricultural land, forests, minerals, fisheries and aquatic products. As of 30 June 1976, 43.3 per cent of the land area has been classified as alienable and disposable while the remaining 56.8 per cent, public forest land.[2] In 1975, most of the disposable land (82.9 per cent) was utilized for agricultural production, both for food and export crops. About one third was used for the growing 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, cotton, rubber and other crops.[3]

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[1] Records kept by the Philippine Atmospheric, Geophysical and Astronomical Services Administration, from 1948 to 1976, show an annual average of 19 tropical cyclones. 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, 1977 Philippine Statistical Yearbook (Manila: 1977), pp. 244-247.

[2] Disposable land totaled 12,975,861 hectares while public forest land occupied 17,024,139 hectares. See ibid., Tables 6.8 and 6.9, pp.262-263.

[3] Ibid., Table 5.2, pp. 208-217.

About 77.4 per cent of the country's timberland is commercial forest, consisting mostly of dipterocarp. Logs and lumber have been among the top ten export earners since 1949. From 1950, it rose from sixth principal export to number one in 1970. However, a ban on logging was imposed by the government because of forest denudation resulting in the destruction of watershed areas and flooding of lowland areas during the monsoon season. Consequently, logs and lumber became the fourth principal export in 1975.

Mineral resources include precious metals such as gold, silver, platinum and palladium, base metals such as copper, iron ore, nickel, chromite ore, molybdenum, pyrite cinders ore, quicksilver (mercury) and zinc and nonmetallics such as gypsum, coal, silica-sand, gravel and sand, etc. Mining and quarrying contributed 2.1 per cent to gross domestic product in 1975. Copper concentrates, gold from copper ores and concentrates, and nickel alloys (unwrought) were among the top fourteen principal exports in 1975, bringing in US$290.3 million. These made up 12.7 per cent of total exports for the year.[4]

The Philippines' geographical location and physical characteristics make it a rich fishing ground. The marine fishery resources, consisting of territorial and insular waters, cover about 1.6 million square miles or 14 times the land area. Maximum productive potential has been estimated from 1.65 to 3.7 million metric tons per year.[5] In 1975, the country recorded a total of 1.34 million metric tons of fish production valued

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[4]National Economic and Development Authority, Report on the Philippine Economy, 1976 (Manila:1977), p. 35.

[5]"Inventory of Philippine Resources," NEDA Development Digest, Vol. IV, No. 5 (31 July 1976), p. 14.

at ₱5,919.1 million. About 37 per cent were contributed by commercial fishing vessels, eight per cent by fishponds and the remaining 54.7 per cent by municipal and sustenance fishing.[6] Despite this, 58,203 thousand kilograms of fish and fish preparation were imported into the country during the same year, valued at US$33.4 million. This was over four times the volume of Philippine export of the same commodity that year which was 13,015 thousand kilograms worth US$16.6 million.[7] Other fishery products gathered and exported included reptile skins, seaweeds, and shells.

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 14 per cent more than the last census of population of 1970 which counted 36,684,486 persons, and was 117 per cent more than the 1949 census of 19,234,182 persons. The annual rate of population growth ranged from 3.01 per cent in 1970 and 1.9 per cent in 1949. In less than three decades, therefore, the 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.[8]

Population density varies among the 12 administrative regions. The national average in 1975 was 139.4 persons per square kilometer compared with 122.3 persons per sq. km. in 1970, 90.3 persons per sq. km.

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[6] 1977 Philippine Statistical Yearbook, op. cit., Table 6.1, p.252.

[7] Ibid., pp. 252, 258-261.

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

in 1960 and 64.1 persons per sq. km. in 1948. Metropolitan Manila Area recorded the highest density with 7,646.2 persons per sq. km. in 1975. There were 6,237.4 persons per sq. km. in the same area in 1970, 3,871 persons per sq. km. in 1960 and 2,467 persons per sq. km. in 1948. Region II, i.e. Cagayan Valley in the north, has the lowest density with 21.3 persons per sq. km. in 1948, 33 persons per sq. km. in 1960, 46.4 persons per sq. km. in 1970, and increasing to 53 persons per sq. km. in 1975.[9]

The population is still predominantly rural. About 33 per cent of the people lived in urban areas and 67 per cent lived in rural areas, according to the 1970 Census.[10] Half of the urban population (50.4 per cent) lived in places with 5,000 to 39,999 persons, six per cent lived in places with 40,000 to 99,000,and 10.7 per cent lived in places with over 100,000 people.[11] By substracting persons classified as urban, but engaged in agricultural occupations from the total urban, reported by the National Census and Statistics Office, the following distribution of

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[9] Ibid., Table 1.1, pp. 26-33.

[10] 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 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.

[11] Mercedes B. Concepcion and Eliseo I. de Guzman,Jr., "The Philippine Population," 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), p. 80.

urban and rural population in the Philippines from 1948 to 1975 can be seen.

Table A-1
Distribution of Population, Urban and Rural, Philippines
1948, 1960, 1970 and 1975 (In Thousands)

Year	Total Population		Urban		Rural	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
1948	19,234	100.00	4,298	22.3	14,936	77.7
1960	27,088	100.00	6,861	25.3	20,227	74.7
1970	36,684	100.00	10,140	27.6	26,544	72.4
1975	42,495	100.00	12,335	29.0	30,160	71.0

Source of data: The Philippines, Priorities and Prospects for Development; A World Bank Country Economic Report (Washington,D.C.: The World Bank, 1976), Table 5.1, p. 93.

The Philippines has a relatively young population with over half (56.8 per cent) of the total in 1970 belonging to the age group 19 years old and below. Those in the age group 20 to 34 years old made up an additional 20.9 per cent of the total. A national survey made in August 1975 showed that 29,751,000 persons were 10 years old or over, making up 71 per cent of an estimated population of 41,831,000. About half of this group (15,161,000) were in the labor force, of which 95.8 per cent (14,517,000) were fully or partially employed. Approximately two thirds of the employed labor force (10,073,000) lived in rural areas. The remaining 4,444,000 employed labor force dwelled in urban areas.

A majority of the urban workers, 90.6 per cent (4,027,000),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 rural

workers were engaged in agriculture, forestry, hunting and fishing. About 37 per cent of all the employed labor force in nonagricultural industries (2,561,000) were found in Region IV which covers Metropolitan Manila Area and the Southern Tagalog provinces.[12]

According to the 1970 Census, 76 per cent of the people who were six years old and over were able to read and write. The literacy rate in urban areas was higher, 86.6 per cent, compared with 71.4 per cent in rural areas. Region **III (Central Luzon provinces) and Region IV** had the highest literacy levels, some 83.2 and 85.1 per cent, respectively.

Income Distribution

There is a great disparity in the distribution of income in the country. During the twelve-month period ending February 1957, 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 received 55.1 per cent of total income. Within this group is included the top 10 per cent which received 39.4 per cent of all family income. The top 5 per cent received 27.7 per cent of total income. The latter group, therefore, got much more share in the family income than the lower 60 per cent which had to share among themselves 25 per cent of the society's total family income.

The average annual income of the lowest 20 per cent in February 1957 was ₱331 while that of the highest 20 per cent had an average income of ₱4,024. The top five per cent had an average income of ₱8,142.

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[12] 1977 Philippine Statistical Yearbook, op.cit., pp. 35-68.

There was little change in the annual distribution of family income in April 1971. The lowest 20 per cent received 3.6 per cent of total while the top 20 per cent received 54 per cent of total family income. Within the latter group, the top 10 per cent received 37.1 per cent of total family income while the top 5 per cent received 24 per cent of total income.

The average annual income among the lowest 20 per cent more than doubled to ₱687, from its February 1957 level of ₱331. The top 20 per cent also experienced a similar growth rate in average income reaching ₱10,079. The top 5 per cent received an average income of ₱18,518 in April 1971 or nearly three times that of the lowest 20 per cent. The increases reflect inflation that had taken place since 1956. Using 1972 as the base year, wage index rates showed the following changes over the period.

Table A-2
Wage Index Rates of Laborers in Industrial Establishments
Manila and Suburbs, Selected Years (1972=100)

Year	Money Wage Rates		Real Wage Rates	
	Skilled Laborers	Unskilled Laborers	Skilled Laborers	Unskilled Laborers
1956	59.8	50.5	138.1	116.6
1961	62.6	51.9	131.2	108.8
1971	95.3	94.4	105.1	104.1
1972	100.0	100.0	100.0	100.0
1975	119.7	120.1	74.4	74.6

Source of data: Republic of the Philippines, National Economic and Development Authority, 1977 Philippine Statistical Yearbook, p. 549.

The average annual income of families for the whole country was ₱3,736 in April 1971. Families in urban areas received higher, ₱5,867, or more than twice that of families in rural areas which received ₱2,818.

Among urban families, those living in the Metropolitan Manila Area received on the average, ₱7,785 compared with those living in other urban areas who got ₱5,141. Table A-3 shows the distribution of family income.

Table A-3
Share of Family Income Received by Quintile
and by Top 5 and 10 Per Cent of Families, 1957, 1961 and 1971

Families ranked from lowest to highest income	Per Cent of Total Family Income			Share of Total Income (₱1,000)		
	1957[a]	1961[b]	1971[c]	1957	1961	1971
Lowest 20 per cent	4.5	4.2	3.6	261,086	337,401	872,237
Second 20 per cent	8.1	7.9	8.1	474,594	632,500	1,932,718
Third 20 per cent	12.4	12.1	13.3	721,177	965,504	3,134,705
Fourth 20 per cent	19.8	19.3	21.0	1,155,359	1,541,002	4,981,219
Fifth 20 per cent	55.1	56.5	54.0	3,212,080	4,505,359	12,793,406
Top 10 per cent	39.4	41.0	37.1	2,296,053	3,273,668	8,790,570
Top 5 per cent	27.7	29.0	24.8	1,611,598	2,314,533	5,876,452
Total	100.0	100.0	100.0	5,824,296	7,981,766	23,714,284

Source of data: National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 508-509.

Details may not add up to totals due to rounding. The average size of a Filipino family is about six members.

[a] Twelve-month period ending February 1957.

[b] Calendar year.

[c] Twelve-month period ending April 1971.

The Economy

The Philippine economy is predominantly agricultural with over one fourth of the Net Domestic Product (NDP) contributed by agriculture, fishery and forestry. The relative contribution of this sector to NDP has been declining since 1960. In 1960, agriculture, fishery and forestry

contributed 34.8 per cent. This went down to 29.7 per cent 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. Manufacturing alone contributed 17.4 per cent in 1960 and 20.8 per cent in 1974. Its average growth rate was 12.2 per cent in 1951-55, 4.5 per cent in 1961-65 and 7.3 per cent in 1970-74.

The service sector (transport, communications and storage, commerce and services) contributed 43.3 per cent to NDP in 1960 and 43.9 per cent in 1974. Commerce registered a 13.8 per cent contribution 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, the Gross National Product grew at an average rate of 8.1 per cent in 1950-55, 5.3 per cent in 1960-65, and 6.1 per cent in 1970-74.[13]

The country's ten principal exports since 1950 have been mainly agricultural, forest and mineral products. These are coconut in the form of copra, dessicated coconut and coconut oil; sugar, abaca, logs and lumber, bananas, pineapples, copper concentrates and gold. In 1950, these products contributed 85.5 per cent to the total value of all exports. This went down to 85.1 per cent in 1960, 80.9 per cent in 1970 and 70.5 per cent in 1975. There has been an increasing trend in exporting more

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[13] Gonzalo M. Jurado, "Industrialization and Trade," in Encarnacion et al, op. cit., pp. 302-303.

of these products in semi-processed form rather than as raw materials. For example, copra's share of the total export earnings decreased from 41.7 per cent in 1950 to 24.7 per cent in 1960 and was only 7.5 per cent in 1970 and 1975. Copra went down from number one export earner to number five in 1975. In contrast, coconut oil contributed 3.8 per cent of total export earnings in 1950, 9 per cent in 1970 and 10 per cent in 1975, rising from fifth place in 1950 to second in 1975. Sugar contributed 13.9 per cent to total value of exports in 1950, 23.8 per cent in 1960, 17.7 per cent in 1970, and 25.3 per cent in 1975. From 1950 to 1973, it was second highest export earner and number one since 1974.[14]

The value of imports into the country has generally exceeded exports. Classified according to end use, imports of consumer goods declined from 36.8 per cent of total in 1949 to 15.9 per cent in 1975. Imports of capital goods have gone up from 13.8 per cent of 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. Table A-4 shows the distribution of imports by end use for selected years.

Agriculture, forestry, hunting and fishing has continued to provide employment for over one half of the employed labor force. In 1956, it provided work for 59 per cent of the labor force. This went down to 56.7 per cent in 1965 and 53.5 per cent in 1975. Some 12.5 per cent of the employed labor force in 1956 were in manufacturing establishments. This decreased to 10.9 per cent in 1965 and increased to 11.4 per cent in 1975. Commerce employed 10.4 per cent of the working force in 1956,

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[14] 1977 Philippine Statistical Yearbook, op. cit., pp. 496-499.

11 per cent in 1971, and 11.2 per cent in 1975. Government, commercial, business and recreational services provided work for 5.1 per cent of the employed labor force in 1956, 7 per cent in 1965, and 9.2 per cent in 1975.

Table A-4
Distribution of Imports by End Use, 1949, 1960, 1970 and 1975
(FOB Value in Million U.S. Dollars)

Imports	1949		1960		1970		1975	
	Value	Per Cent	Value	Per Cent	Value	Per Cent	Value	Per Cent
Consumer Goods	215.7	36.8	99.6	16.5	125.5	11.5	551.4	15.9
Capital Goods	80.6	13.8	223.3	37.0	413.6	37.9	1,148.9	33.2
Raw Materials and Intermediate Goods	289.6	49.4	281.0	46.5	551.0	50.5	1,758.9	50.8
Total	585.9	100.0	603.9	100.0	1,090.1	100.0	3,459.2	100.0

Source of data: National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 500-503.
Details may not add up to totals due to rounding.

Table A-5 shows the number of employed persons by major industry group.

By occupational groups, persons employed as farmers, farm laborers, fishermen, loggers and related workers made up 58.8 per cent of the employed labor force in 1956 and 53.1 per cent in 1975. Craftsmen and production process workers comprised 13.9 per cent of the employed labor force in 1956 and 12.1 per cent in 1975. Sales workers increased from 5.9 per cent of the employed labor force in 1956 to 9.7 per cent in 1975. Service and related workers also increased from 7 per cent of the employed labor force in 1956 to 8.6 per cent in 1975. Professional and technical workers comprised 2.8 per cent in 1956 and grew to 5.5 per cent of the employed labor force in 1975. Table A-6 shows the number of employed persons by major occupations for selected years from 1956 to 1975.

The number of manufacturing establishments has been growing. There

Table A-5
Employed Persons by Major Industry Group
1956, 1961, 1965, 1971 and 1975 (In Thousands)

Industry Group	Oct. 1956		Oct. 1961		Oct. 1965		Nov. 1971		Aug. 1975	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Agriculture, Forestry, Hunting and Fishing	4,548	59.0	5,514	60.6	5,725	56.7	6,321	50.4	7,768	53.5
Mining and Quarrying	31	0.4	31	0.3	24	0.2	59	0.5	54	0.4
Construction	198	2.6	230	2.5	295	2.9	420	3.4	456	3.1
Manufacturing	962	12.5	1,026	11.3	1,101	10.9	1,439	11.5	1,651	11.4
Electricity, Gas, Water and Sanitary Services	26	0.3	19	0.2	22	0.2	49	0.4	46	0.3
Commerce	803	10.4	873	9.6	1,114	11.0	1,559	12.4	1,623	11.2
Transport, Storage and Communication	228	3.0	278	3.1	339	3.4	529	4.2	492	3.4
Government, Commerce, Business and Recreational Services	392	5.1	538	5.9	708	7.0	1,196	7.5	1,335	9.2
Domestic Services	332	4.3	368	4.0	500	5.0	666	5.3	782	5.4
Personal Services Other than Domestic	135	1.8	179	2.0	227	2.2	278	2.2	272	1.9
Industry Not Reported	47	0.6	39	0.4	47	0.5	27	0.2	39	0.3
Total	7,702	100.0	9,095	100.0	10,102	100.0	12,543	100.0	14,518	100.0

Source of data: National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 42-46.

Details may not add up to totals due to rounding.

Table A-6
Employed Persons by Major Occupation Group
1956, 1961, 1965, 1971 and 1975 (In Thousands)

Occupation Group	Oct. 1956		Oct. 1961		Oct. 1965		Nov. 1971		Aug. 1975	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Professional and Technical Workers	216	2.8	309	3.4	375	3.7	699	5.6	805	5.5
Proprietors, Managers and Administrators	352	4.6	340	3.7	432	4.3	174	1.4	148	1.0
Clerical Workers	153	2.0	273	3.0	352	3.5	449	3.6	556	3.8
Sales Workers	456	5.9	537	5.9	675	6.7	1,419	11.3	1,415	9.7
Farmers, Farm Laborers, Fishermen, Loggers and Related Workers	4,525	58.8	5,501	60.5	5,677	56.2	6,286	50.1	7,713	53.1
Workers in Mines and Quarries	30	0.4	23	0.2	14	0.1	33	0.3	27	0.2
Transportation and Communications Workers	145	1.9	184	2.0	272	2.7	517	4.1	493	3.4
Craftsmen and Production Process Workers	1,071	13.9	1,100	12.1	1,270	12.6	1,578	12.6	1,755	12.1
Manual Workers and Laborers, N.E.C.*	171	2.2	168	1.8	151	1.5	229	1.8	321	2.2
Service and Related Workers	541	7.0	636	7.0	840	8.3	1,136	9.0	1,255	8.6
Occupations Not Reported	41	0.5	29	0.3	42	0.4	24	0.2	29	0.2
Total	7,701	100.0	9,100	100.0	10,100	100.0	12,544	100.0	14,517	100.0

Source of data: National Economic and Development Authority, 1977 Philippine Statistical Yearbook, pp. 52-59.

Details may not add up to totals due to rounding.

*Not elsewhere classified.

were 13,313 manufacturing establishments which employed 5 or more workers in 1974. These hired a total of 531,973 workers with a combined gross output of ₱47,553 million for the year.[15] According to industry group, manufacturing establishments for food (numbering 3,833 or 28.8 per cent of total) and footwear and wearing apparel (some 3,879 or 29.1 per cent) made up the largest group. Establishments producing machinery and chemicals made up a mere 2.2 per cent and 2.1 per cent, respectively.

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 rice varieties 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 always a key issue in Philippine politics and elections.

The country's continuing reliance on traditional agricultural exports leaves the economy vulnerable to the vicissitudes of climate and

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[15] Ibid., pp. 292-293.

conditions 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 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 to pay for oil imports during that period.

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 living standards in the rural areas, unemployment and underemployment, inflation and the rising levels of expectations among the general population as a consequence of the progress in the means of mass communications.

The foregoing socioeconomic data 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 in these fields appropriate to the rural setting. 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, indus-

tries that are labor rather than capital intensive 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, since independence, tried 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 were 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 thus 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 reoriented to integrate the social aspects of economic development. From the 1960s on such plans included programs for the development of education, promotion of health, skills training, agricultural extension and agricultural credit, and community development. A landmark was the enactment of the

Agricultural Land Reform Code in 1963 which abolished sharecropping tenancy and created leasehold farmers.[16] These 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 and redirect investments in landholdings to provide the much needed capital for industrialization thus bringing about a restructuring of the economy and society.

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 national legislative body. The new political order has stepped up the implementation of agrarian reform 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 opportunities, achievement of more equitable distribution of income and wealth, acceleration of economic growth, promotion of regional development, and maintenance of price stability. The components of the Plan's social development program include population control through family planning, improvement of health and nutrition, education and manpower development (including a science development program), housing, expansion of employment opportunities, social welfare, and community development projects. The development plan is a comprehensive one, recognizing the interdependence of the various sectors and economic activities in the attainment of national goals and objectives.

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

The Five Year Development Plan (1978-82) and the Long Term Development Plan up to 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.[17]

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[17] 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.

Appendix B. Institutions Represented in Survey of Educators

The U.P.: State University in the Metropolitan Area

As shown in Chapter III, the largest concentration of colleges and universities are found in Region IV which covers the Metropolitan Manila Area (MMA) and Southern Luzon provinces. In the four chartered cities of the MMA (Manila, Quezon City, Caloocan City and Pasay City), there were 2 state and 17 private universities, 2 state and 66 private colleges as of school year 1975-76.[1] In the city of Manila alone were located 1 state and 15 private universities, 2 state and 39 private colleges.

The University of the Philippines System in Metropolitan Manila is the country's oldest and largest state university with the most comprehensive programs of study in science and engineering. Its main campus is located in Diliman, Quezon City, where its colleges of Arts and Sciences, Engineering, Fisheries, Home Economics, Pharmacy, Veterinary Medicine and other professional institutes and schools are found. In the same campus are several science research centers: Natural Science Research Center, National Hydraulic Research Center, Engineering Industrial Research Center and others. The colleges of Medicine and Dentistry, Institute of Public Health and School of Allied Professions are found in its old campus in Manila.

The U.P. System in the MMA offers 19 undergraduate programs in the sciences leading to baccalaureate degrees. These are in chemistry, geology, biology, botany, geography, marine science, mathematics, physics, premedicine, psychology, zoology, fisheries, food technology, community nutrition,

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[1] Republic of the Philippines, Department of Education and Culture, Planning Service, Project Development and Evaluation Division, "Public and Private Universities/Colleges by Region as of 1975," mimeo.

pharmacy, industrial pharmacy, statistics,hygiene, occupational therapy and physical therapy. There are undergraduate programs in the social sciences, humanities, speech and drama, mass communications, economics, business administration, education and home economics. Graduate programs leading to the master of science/arts degrees are offered, 20 of which are in the sciences. These include the Master of Science in biology, chemistry, botany, marine biology, mathematics, physics, zoology, oceanography, biochemistry, pharmacology and others. The Doctor of Philosophy degree is offered in botany, environmental sciences, geology, mathematical science, psychology, food science, pharmaceutical chemistry, pharmacy and statistics. The professional doctor's degree is offered in medicine, dental medicine and veterinary medicine.

There are eight undergraduate programs in engineering covering chemical, civil, electrical, geodetic, industrial, mechanical, metallurgical and mining engineering. Graduate programs leading to the Master of Science are also available in these eight fields as well as a general program leading to the Master of Engineering. The latter program is especially designed for teachers in engineering schools.

The U.P. at Los Baños, Laguna, is an autonomous university in the U.P. System. Located some 60 kilometers south of the Metropolitan Manila Area, it began as the U.P. College of Agriculture in 1908. It became an autonomous university within the U.P. System in 1972. Since then, it has grown into several colleges and institutes offering degree programs in the agricultural and natural sciences, forestry and agricultural engineering. There are 14 undergraduate programs in the U.P. at Los Baños in agriculture, agricultural chemistry, agricultural engineering, food science and technology, soil science, forestry, forest products engineering, biology,

chemistry, mathematics, zoology and others. Graduate programs leading to the Master of Science are offered in over 30 fields of specialization such as agricultural botany, animal science, microbiology, plant pathology, genetics, phycology, vertebrate biology and others. The Doctor of Philosophy is offered in over 25 fields in the sciences, forestry and agriculture.

Several research units have been established in the U.P. at Los Baños: Dairy Training and Research Institute, Institute of Plant Breeding, Animal Science Center, National Crop Protection Center and a number of centers for research in agrarian reform, cooperatives and policy studies. The International Rice Research Institute, a privately funded research and training center serving Asian countries, the Forest Products Research and Development Commission of the National Science Development Board, Forest Products Research Institute of the Department of Natural Resources, the Philippine Council for Agriculture and Resources Research and the Southeast Asian Regional Center for Graduate Study in Agriculture (SEARCA) are located in the campus of the U.P. at Los Baños. The U.P. provides the faculty of instruction and resource persons for SEARCA activities and programs. The SEARCA, in turn, grants financial assistance to the U.P. at Los Baños in the form of professorial chairs.[2]

Regional Colleges and Universities

The Isabela State College of Agriculture provides a contrast to the U.P. at Los Baños. It is a small, recently chartered state college (1972) located in Echague, province of Isabela. Isabela is part of the country's

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[2]"American, Asian Educators Applaud UPLB-SEARCA-IRRI Development Efforts," The UPLB Horizon, Vol. III, No. 8 (August 1975), p. 1.

least populated region, the Cagayan Valley (Region II), but is its biggest and most populated province. The Isabela State College of Agriculture (ISCA) began as an intermediate agricultural school in 1923 and grew into its present status as a state college. It is one of two state colleges in Isabela province, the other one being the Cagayan Valley Institute of Technology in Cabagan. ISCA, with a total enrollment of 4,678 in school year 1976-77 (2,989 undergraduate and graduate, and 1,689 secondary students) is the biggest state college in the Cagayan Valley Region as well as the entire Northern Luzon.[3] There are no private or state universities in the Cagayan Valley. However, there are several state and private colleges and public vocational/technical schools.

ISCA is located in a primarily agricultural area. The principal crops produced in Isabela are rice, corn, tobacco, peanuts, fruits and vegetables. The province is also rich in forest resources. Manufacturing activities consist mainly of sawmills, rice mills and cottage industries. The science and technology courses in ISCA are primarily oriented to agriculture and forestry. As of school year 1976-77, ISCA had six undergraduate programs, three of which were in agriculture (agronomy, horticulture, and animal husbandry), one in forestry, one in agricultural engineering and one in agricultural education. The ten-year development program of ISCA envisions the addition of programs leading to the Bachelor of Science in agricultural chemistry, statistics and fisheries; and the Doctor of Veterinary Medicine degree. At present, graduate programs offered at the master's

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[3] Isabela State College of Agriculture, Ten-Year Development Plan, 1976-77 to 1985-86 (Echague: 1976, mimeo.), pp. 1-4, 52.

level are in agricultural education, agronomy, animal husbandry and education or teaching.[4]

The Central Luzon State University (CLSU), like ISCA, is located in an agricultural area, three kilometers from the town of Muñoz in Nueva Ecija. Nueva Ecija, together with other provinces of Central Luzon (Region III), make up the central plains of Luzon which is the country's traditional rice basket. Sugar is an important crop in the region, especially in Pampanga and Tarlac. In the region are found, aside from CLSU, one private university, five state and 44 private colleges, several public vocational/technical schools and community colleges. CLSU's program thrusts in science and technology are focused primarily on agriculture and related industries. It has undergraduate programs leading to the Bachelor of Science in agriculture (major in horticulture, agronomy, animal husbandry, soil science, and others), in fisheries, agricultural engineering and home industry (major in food processing and clothing and textiles). Its graduate programs lead to the Master of Science in dairy production, horticulture and agricultural education.

In the Visayan islands, the colleges and universities included in the study are located in Iloilo City,in the West Visayas (Region VI), and Cebu City, in the Central Visayas (Region VIII). Iloilo City is the third largest city outside the Metropolitan Manila Area. Its population in 1970 was 200,000, representing 1.7 per cent of the country's urban population.[5]

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[4] Ibid., pp. 79-90.

[5] The Philippines; Priorities and Prospects for Development; A World Bank Country Economic Report (Washington, D.C.: The World Bank, 1976), Table 3.1, p. 43.

There are several institutions of higher learning in the city: U.P. College Iloilo, West Visayas State College, University of San Agustin, Central Philippine University and University of Iloilo. The last three are private institutions.

The U.P. College Iloilo is a regional unit of the University of the Philippines System. Its undergraduate programs in science include the biological sciences, natural sciences and premedicine. The West Visayas State College was set up in 1924 as the Iloilo Normal School, one of the eight pioneer public normal schools in the country for the training of elementary school teachers. It was converted into the West Visayas State College (WVSC) by Republic Act No. 4189 (4 May 1965). The WVSC has a consortium (since 24 September 1974) with U.P. College Iloilo and Central Philippine University to "ensure quality education at minimum cost by a sharing of resources, faculty and facilities as well as to find worthy causes for joint ventures in research and community services which require the cooperation of institutions of higher learning."[6] In 1974, WVSC was designated as the Regional Staff Development Center of the Educational Development Projects Implementing Task Force (EDPITAF) of the Department of Education and Culture. The College is also the Regional Science Training Center for elementary and mathematics teachers for Eastern and Western Visayas. Aside from its degree programs in education, WVSC offers courses leading to the Bachelor of Science in Agriculture (major in agribusiness, animal science, plant science) and the Bachelor of Arts, major in science. The latter course prepares students for admission to its School of Medicine

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[6]West Visayas State College, Bulletin of Information, 1976, (Iloilo City: 1976), p. 2.

which opened in 1975. The WVSC School of Medicine is the first medical school in the Western Visayas region and the second state-owned medical institution. The medical school offers the four-year Doctor of Medicine degree.

The University of San Agustin and Central Philippine University in Iloilo City are private sectarian universities. The University of San Agustin is run by the Augustinian Fathers (of the Province of the Most Holy Name of Jesus of the Philippines). The school was opened in 1904, expanding gradually and became a university in 1953. Its average annual collegiate enrollment for school years 1972-73 to 1976-77 is over 8,100. It offers undergraduate programs in the sciences and engineering leading to the Bachelor of Science in biology, psychology, food and nutrition, pharmacy, chemistry, nursing, medical technology and four branches of engineering (civil, mechanical, chemical,electrical) and architecture. The University's other undergraduate programs are in education, commerce and law. Its graduate programs are in economics, business administration and education.[7]

The Central Philippine University (CPU) was founded as a school in 1905 by the Foreign Baptist Mission in the United States. Its programs grew over the years and became a university in 1953. CPU is presently run by the Baptist Church in the Philippines. Its collegiate enrollment in school year 1975-76 was 5,200 students. Its undergraduate programs in the sciences and agriculture lead to the Bachelor of Science in agronomy, animal husbandry, agricultural engineering, biology, mathematics, chemistry as well as nursing and medical technology. It also offers undergraduate

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[7]University of San Agustin, General Catalog, 1976-77 (Iloilo City: 1976).

degree programs in four branches of engineering: civil, chemical, electrical and mechanical. CPU's College of Engineering was selected in 1977 by EDPITAF as one of the 20 engineering schools which will participate in the government's program of reforming and upgrading engineering education. The government will assist CPU by extending it soft, long-term loans which the latter will use to finance its laboratory equipment, facilities and advanced training of its engineering faculty and administrators.

For the Central Visayas region, two schools in Cebu City (U.P. College Cebu and University of San Carlos) were included in the survey. Cebu City is the country's second largest city outside the Metropolitan Manila Area. Its population in 1970 was 347,000, representing 2.9 per cent of the total urban population in the Philippines.[8] As of school year 1976-77, there were four private universities in Cebu City of which the University of San Carlos (USC) is the oldest and biggest in enrollment. There were 11 private colleges. There were two medical schools in the city -- the M.H. Aznar Memorial College of Medicine of Southwestern University and Cebu Institute of Medicine. Two more medical schools were to open in school year 1977-78 -- the Don Vicente R. Gullas Memorial Medical Foundation at the University of the Visayas and Cebu Doctors College of Medicine at the Cebu Doctors Hospital.

USC is the second largest of 12 Catholic universities in the country.[9] Its total enrollment in school year 1976-77 was 15,711 of which 10,232 (65 per cent) were in its undergraduate and graduate programs. USC was

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[8] The Philippines; Priorities and Prospects for Development, loc. cit.

[9] The biggest Catholic university is the University of Santo Tomas in Manila.

founded in 1595 by Jesuit missionaries. In 1935, the school was taken over by the Divine Word Fathers (SVD). USC became a university in July 1948. In school year 1976-77, USC had 378 faculty members distributed in eight units: the colleges of Arts and Sciences, Commerce and Business Administration, Law, Education, Engineering, Pharmacy, Nursing and Graduate School. The University has several research centers and training units such as the Hydrological Research and Training Unit, Marine Biology Station and others. A Coconut Foods Pilot Plant was also set up by USC in 1962 (from a grant of more than a million deutschmark) to undertake experiments in the chemical processing of coconut oil. The experiments were suspended in 1965 because the University could not meet the growing operating expenses of the plant. In 1973, the plant was renovated and taken over by the Philippine Government through the National Science Development Board, Department of Agriculture and Natural Resources and Philippine Coconut Authority.[10]

Several undergraduate programs leading to the Bachelor of Science degree are offered at the University of San Carlos. These include general biology, marine biology, mathematics, physics, chemistry, pharmacy, nursing, engineering -- civil, chemical, electrical,mechanical, and architecture. There are 16 graduate programs leading to the Master of Science/Arts degree in biology, chemistry, mathematics, physics and science teaching. USC's College of Engineering has been chosen by EDPITAF as one of 20 engineering schools to participate in the government program of upgrading engineering education.

The U.P. College Cebu is another regional unit of the U.P. System. It offers several undergraduate and graduate courses such as the Bachelor

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[10]University of San Carlos, Report, 1976 (Cebu City: 1976).

of Science in Agriculture (major in agronomy, animal husbandry, agricultural engineering) and in the Biological Sciences. At the time of my interviews, U.P. College Cebu had submitted to Diliman a proposal for the creation of a Marine Sciences Center attached to it which would offer degree programs, undertake researches and community extension services. The proposed degree programs include the Bachelor of Science in Marine Sciences with fields of specialization in marine biology and oceanography and the Master of Science in Marine Sciences with concentration in marine biology, biological oceanography and general oceanography.[11]

Xavier University, in Cagayan de Oro City, was chosen for the interviews in the Northern Mindanao Region (Region X). Cagayan de Oro City is the ninth largest city in the Philippines outside Metropolitan Manila, with a population of 124,000 as of 1970, or 1.1 per cent of the total urban population of the country.[12] Owned by the Jesuit Fathers, Xavier University is the only private university in the region which has 38 private colleges, one state college and a state university, both of which are in Bukidnon province. There are five other private colleges in Cagayan de Oro City. Xavier University was founded in 1933 as the Ateneo de Cagayan and became a university in 1957. As of school year 1975-76, the University had a collegiate enrollment of 2,700 and 147 faculty members. It offers several undergraduate programs in the sciences as biology, chemistry, marine biology and agriculture (with concentration in agronomy,

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[11] University of the Philippines College Cebu, Center for Regional Development Operations, U.P. College Cebu Marine Sciences Center: A Proposal (Lahug, Cebu City: March 1977, mimeo.).

[12] The Philippines; Priorities and Prospects for Development, loc. cit.

animal husbandry or agricultural economics). The University offers graduate programs in various fields leading to the Master of Arts degree.

For the Southern Mindanao Region (Region XI), two schools -- University of Mindanao and Ateneo de Davao College -- in Davao City, were included in the interviews. Davao City is the largest city outside of Metropolitan Manila Area with a population of 392,000, or 3.2 per cent of the country's urban population.[13] As of school year 1976-77, there were two private universities (both in Davao City) and 47 private colleges in the region. At the time of my interviews, a U.P. College Davao was to open in Davao City.

The University of Mindanao (UM) is a private school organized as a stock corporation. Founded in 1946, it became a university in 1965. UM's campus is located in the downtown area of Davao City just like many private universities in downtown Manila. In school year 1976-77, UM's collegiate population reached 13,000 of which 4,085 were enrolled in engineering courses. The undergraduate programs in engineering lead to the Bachelor of Science degree in civil, chemical, electrical, mechanical engineering and architecture. In 1960, the University set up a nonstock, nonprofit teaching and research institution, the Mt. Apo Science Foundation. Located in a 100-hectare campus some 30 minutes drive from Davao City's urban center, the Foundation, which is certified by the National Science Development Board as bona fide foundation dedicated to scientific education and research, is supported by funds from the University and private donations. Its programs are mainly for undergraduate degrees in agriculture, arts and sciences, forestry and engineering. Most of its students enjoy scholarships which include free tuition, textbooks, housing and meals. Some of the teaching

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[13] Ibid.

staff are U.S. Peace Corps Volunteers, British Volunteers Overseas and Japanese Overseas Volunteers.

The Ateneo de Davao College is a school run by the Jesuits. It offers undergraduate programs which include, among others, the Bachelor of Science in biology, chemistry, mathematics and agriculture. The College has a consortium with Brokenshire Hospital in Davao City to set up the Davao Medical School, the first such school in Mindanao, starting in school year 1977-78. The medical degree will be granted by the Ateneo de Davao College but the faculty, library, laboratory and hospital facilities will be shared with Brokenshire Hospital. The goal of the new medical education program is to produce doctors for Mindanao rather than for Manila or the United States. Hence, its curriculum will be geared to rural medical practice. The students will be selected for admission to the school on the basis of intelligence and their commitment to serve in the area.[14]

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[14]Interview with Fr. Emeterio J. Barcelon, S.J., President, Ateneo de Davao College, Davao City, 21 April 1977.

BIBLIOGRAPHY

I. BOOKS

Adams, Walter, ed. The Brain Drain. New York: The Macmillan Co., 1968.

Agoncillo, Teodoro A. Malolos: The Crisis of the Republic. Quezon City: University of the Philippines Press, 1960.

_____. A Short History of of the Philippines. "Mentor Book"; New York: The New American Library, 1969.

Alzona, Encarnacion. A History of Education in the Philippines, 1565-1930. 1st ed. Manila: University of the Philippines Press, 1932.

Aucoin, Peter and French, Richard. Knowledge, Power and Public Policy. Science Council of Canada, Special Study No. 25; Ottawa: Information Canada, November 1974.

Babbage, Charles. Reflections on the Decline of Science in England and Some of Its Causes. First edition published in London, 1830; re-issued in Shannon, Ireland: Irish University Press, 1971.

Babbit, J.D., ed. Science in Canada; Selections from the Speeches of E.W.R. Steacie. Toronto: University of Toronto Press, 1965.

Barnett, Andrew, Pyle, Leo and Subramanian, S.K. Biogas Technology in the Third World; A Multidisciplinary Review. Ottawa: International Development Research Centre, 1978.

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

Bernal, J.D. The Social Function of Science. Published in London: Routledge and Kegan Paul, 1939, reissued in Cambridge, Mass.: The M.I.T. Press, 1967.

Bernardino, Vitaliano. Planning Education for National Development. Manila: Department of Education, Bureau of Public Schools, 1966.

Bhagwati, Jagdish, ed. The Brain Drain and Taxation: II. Theory And Empirical Analysis. Amsterdam: North Holland Publishing Co., 1976.

_____ and Partington, Martin, eds. Taxing the Brain Drain: I. A Proposal. Amsterdam: North Holland Publishing Co., 1976.

Blume, Stuart S. Toward A Politicial Sociology of Science. New York: The Free Press, 1974.

Bowring, Sir John. A Visit to the Philippine Islands. London: Smith Elder & Co., 1859.

Boyd, A.D. and Gross, A.C. Education and Jobs; Career Patterns Among Selected Canadian Science Graduates with International Comparisons. Science Council of Canada, Special Study No. 28; Ottawa: Information Canada, June 1973.

Boyle, Godfrey and Harper, Peter, eds. Radical Technology. New York: Pantheon Books, 1976.

Bronwell, Arthur B., ed. Science and Technology in the World of the Future. New York: John Wiley & Sons, 1970.

Brooks, Harvey. The Government of Science. Cambridge, Mass.: The M.I.T. Press, 1968.

Bush, Vannevar. Pieces of the Action. New York: William Morrow & Co., Inc., 1970.

Buss, Claude A. The United States and the Philippines; Background for Policy. AEI-Hoover Policy Studies 23; Washington, D.C.: American Enterprise Institute for Public Policy Research, 1977.

Campos, Paulo C. and Velasco, Jose R., eds. Proceedings of the Philippine Association for the Advancement of Science, 1970. Quezon City: Capitol Publishing House, Inc., 1970.

Cardwell, D.S.L. The Organization of Science in England; A Retrospect. Melbourne: Heinemann, 1957.

Cariño, Ledivina V. The Role of Professions in National Development. Manila: University of the Philippines, College of Public Administration, 1973, mimeo.

Carnoy, Martin. Education as Cultural Imperialism. New York: David McKay Co., Inc., 1974.

Case, Harry L. and Bunnell, Robert A. The University of the Philippines; External Assistance and Development. East Lansing: Institute for International Studies in Education, Michigan State University, 1970.

Conant, James B. Science and Common Sense. New Haven and London: Yale University Press, 1974.

Congdon, R.J., ed. Introduction to Appropriate Technology; Toward a Simpler Life-Style. Emmaus, Penn.: Rodale Press, 1977.

Constantino, Renato. The Filipinos in the Philippines and Other Essays. Manila: Malaya Books, 1966.

_____. The Philippines: A Past Revisited. Quezon City: Tala Publishing Services, 1975.

Cotgrove, Stephen F. and Box, Steven. Science, Industry and Society; Studies in the Sociology of Science. London: Allen and Unwin, 1970.

Dixon, Bernard. What is Science For. New York: Harper and Row, 1973.

Doern, G. Bruce. Science and Politics in Canada. Montreal: McGill-Queen's University Press, 1972.

Dupré, J. Stephan and Lakoff, Sanford A. Science and the Nation; Policy and Politics. Englewood Cliffs, N.J.: Prentice-Hall, 1962.

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

Education and World Affairs, Committee on the International Migration of Talent. The International Migration of High Level Manpower; Its Impact on the Development Process. New York: Praeger, 1970.

Elliot, Charles Burke. The Philippines to the End of the Commission Government: A Study in Tropical Democracy. New York: Greenwood Press Publishers, 1968.

Encarnacion, Jr., Jose, et al. Philippine Economic Problems in Perspective. Quezon City: Institute of Economic Development and Research, School of Economics, University of the Philippines, 1976.

Fernando, Antonio S., ed. The Golden Book of the Philippine Medical Association. Manila: Philippine Medical Association, 1955.

Forbes, W. Cameron. The Philippine Islands, Vol. I. Boston and New York: Houghton Mifflin, Co., 1928.

Gilpin, Jr., Robert G. France in the Age of the Scientific State. Princeton, N.J.: Princeton University Press, 1968.

Gilpin, Robert and Wright, Christopher, eds. Scientists and National Policy-Making. New York: Columbia University Press, 1964.

Glaser, William and Habers, G. Christopher. The Brain Drain: Emigration and Return. UNITAR Research Report No. 22; Oxford/New York: Pergamon Press, 1978.

Goldsmith, Maurice, ed. Science and Social Responsibility. London and Basingstoke: The Macmillan Press, 1975.

_____ and Mackay, Alan, eds. Society and Science. New York: Simon and Schuster, 1964.

Gordon, J. King, ed. Canada's Role in Science and Technology for Development; Proceedings of a symposium held at the Ontario Science Centre, Toronto, Canada, 10-13 May 1979. Ottawa: International Development Research Centre, 1979.

Green, Allan G. Immigration and the Post War Canadian Economy. Toronto: The Macmillan Co. of Canada, 1976.

Grove, J.W. Government and Industry in Britain. London: Longmans, Green and Co., Ltd., 1962.

Grubel, Herbert G. and Scott, Anthony. The Brain Drain: Determinants, Measurement and Welfare Effects. Waterloo, Ontario: Wilfred Laurier University Press, 1977.

Haberer, Joseph, ed. Science and Technology Policy. Lexington, Mass.: D.C. Heath & Co., 1977.

Harbison, Frederick H. Human Resources as the Wealth of Nations. New York: Oxford University Press, 1973.

Harré, Rom, ed. Problems of Scientific Revolution; Progress and Obstacles to Progress in the Sciences; The Herbert Spencer Lectures, 1973. Oxford: Clarendon Press, 1975.

Harrison, Francis Burton. The Cornerstone of Philippine Independence: A Narrative of Seven Years. New York: The Century Co., 1922.

Hartendorp, A.V.H. Short History of Industry and Trade in the Philippines. Manila: American Chamber of Commerce of the Philippines, 1953.

_____. History of Industry and Trade in the Philippines. 2 Vols. Manila: American Chamber of Commerce of the Philippines, 1958.

Hayden, Joseph Ralston. The Philippines: A Study in National Development. New York: The Macmillan Co., 1942.

Henderson, Gregory. Emigration of Highly Skilled Manpower from Developing Countries. UNITAR Research Report No. 3; New York: United Nations Institute for Training and Research, 1970.

Isidro, Antonio and Ramos, Maximo D. Private Colleges and Universities in the Philippines. Quezon City: Alemar's, 1973.

Jenkins, Shirley. American Economic Policy Toward the Philippines. Stanford: Stanford University Press, 1953.

Jones, Graham. The Role of Science and Technology in Developing Countries. Oxford: Oxford University Press, 1971.

Kargon, Robert H. Science in Victorian Manchester; Enterprise and Expertise. Baltimore and London: The Johns Hopkins Press, 1977.

King-Hele, Desmond. Doctor of Revolution; The Life and Genius of Erasmus Darwin. London: Faber and Faber, 1977.

Knight, David. The Nature of Science; The History of Science in Western Culture Since 1600. London: Andre Deutsch, 1976.

Landé, Carl H. Leaders, Factions and Parties: Philippine Politics. Monograph Series No. 6; New Haven, Conn.: Yale University, Southeast Asia Studies, 1965.

Langrish, John, et al. Wealth from Knowledge. New York: Halsted Press, 1972.

Le Roy, James A. Philippine Life in Town and Country. New York and London: G.P. Putnam's Sons, 1905.

Long, T. Dixon and Wright, Christopher, eds. Science Policies of Industrial Nations. New York: Praeger, 1975.

Mabini, Apolinario. The Philippine Revolution. Translated into English by Leon Ma. Guerrero. Manila: Department of Education, National Historical Commission, 1969.

MacMicking, Robert. Recollections of Manilla and the Philippines During 1848, 1849 and 1850. Ed. and Annotated by Morton J. Netzorg. First published in London: Richard Bentley, 1851; reprinted in Manila: Filipiniana Book Guild, 1967.

Management Committee of SCITEC and West, Allen S. National Engineering, Scientific and Technological Societies of Canada. Science Council of Canada, Special Study No. 25; Ottawa: Information Canada, December 1972.

Marcos, Ferdinand E. The Democratic Revolution in the Philippines. Foreword by Carlos P. Romulo. 2nd ed. Manila: 1977.

Mathias, Peter, ed. Science and Society 1600-1900. Cambridge: Cambridge University Press, 1972.

Maybury, Robert H. Technical Assistance and Innovation in Science Education. New York: John Wiley & Sons, 1975.

Medina, Florencio A. Science, Development, Higher Education, Perspectives. Manila: NSDB, April 1975.

Merton, Robert. The Sociology of Science. Ed. with an Introduction by Norman Storer. Chicago, Ill.: University of Chicago Press, 1973.

Miller, Hugo. Economic Conditions in the Philippines. Rev. ed. Boston: Ginn and Company, 1920.

Montgomery, John D. Technology and Civic Life; Making and Implementing Development Decisions. Cambridge, Mass.: The M.I.T. Press, 1974.

Moravcsik, Michael. Science Development; The Building of Science in Less Developed Countries. Bloomington: Indiana University, PASITAM, 1976.

Nader, Claire and Zahlan, A.B., 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.

Organization for Economic Co-operation and Development. Fundamental Research and the Policies of Governments. Paris: OECD, 1966.

_____. Government and Allocation of Resources to Science. Paris: OECD, 1966.

_____. Ministers Talk About Science. Paris: OECD, 1965.

_____. Problems of Science Policy. Paris: OECD, 1968.

_____. Review(s) 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.)

_____. Science, Growth and Society; A New Perspective. Paris: OECD, 1971.

_____. Science and Technology in the People's Republic of China. Paris: OECD, 1977.

Ornstein, Martha. The Role of Scientific Societies in the Seventeenth Century. Published by the University of Chicago, 1928; reprinted in London: Archon Books, 1963.

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

_____. Science Since Babylon. Enl. ed. New Haven: Yale University Press, 1975.

Ravetz, Jerome R. Scientific Knowledge and Its Social Problems. Oxford: Clarendon Press, 1971.

Restivo, Sal P. and Vanderpool, Christopher K., eds. Comparative Studies in Science and Society. Columbus, Ohio: Charles E. Merrill Publishing Co., 1974.

Richter, Maurice N. Science as a Cultural Process. Cambridge, Mass.: Schenkman Publishing Co., Inc., 1972.

Ridley, Charles P. China's Scientific Policies; Implications for International Cooperation. AEI-Hoover Policy Study 20; Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976.

Rizal, Jose. The Reign of Greed (El Filibusterismo). Trans. by Charles Derbyshire. Manila: Philippine Education Co., 1956.

Robles, Eliodoro G. The Philippines in the Nineteenth Century. Quezon City: Malaya Books Inc., 1969.

Rose, Hilary and Rose, Steven. Science and Society. London: The Penguin Press, 1969.

_____, eds. The Political Economy of Science; Ideology of/in the Natural Sciences. London & Basingstoke: The Macmillan Press Ltd., 1976.

_____, eds. The Radicalisation of Science; Ideology of/in the Natural Sciences. London & Basingstoke: The Macmillan Press Ltd., 1976.

Salomon, Jean Jacques. Science and Politics. Trans. by Nöel Lindsay. London and Basingstoke: MacMillan, 1973.

Schaffter, Dorothy. The National Science Foundation. New York: Frederick A. Praeger, 1969.

Schumacher, E.F. Small is Beautiful; A Study of Economics as if People Mattered. London: Abacus, 1974.

Science Forum 1974 on National Development: Its Scientific and Technological Manpower Component; Papers and Proceedings. Los Baños, Philippines: Society for the Advancement of Research, Inc., April 1974.

Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968.

Shils, Edward, ed. Criteria for Scientific Development: Public Policy and National Goals. Cambridge, Mass.: The M.I.T. Press, 1968.

Slayton, Philip and Trebilcock, Michael J., eds. The Professions and Public Policy. Toronto: University of Toronto Press, 1978.

Spaey, Jacques, et al. Science for Development; An Essay on the Origin and Organization of Science Policies. Paris: UNESCO, 1971.

Spiegel-Rösing, Ina and Price, Derek de Solla, eds. Science, Technology and Society; A Cross-Disciplinary Perspective. London and Beverly Hills: Sage Publications, 1977.

Spurgeon, David, ed. Give Us the Tools; Science and Technology for Development. Ottawa: International Development Research Centre, 1979.

Stauffer, Robert. The Development of an Interest Group: The Philippine Medical Association. Quezon City: University of the Philippines Press, 1966.

Suttmeier, Richard P. Research and Revolution; Science Policy and Societal Change in China. Lexington, Mass.: Lexington Books, 1974.

Taylor, Sir James. The Scientific Community. London: Oxford University Press, 1973.

Teich, Albert H., ed. Scientists and Public Affairs. Cambridge, Mass.: The M.I.T. Press, 1974.

Tui, Frank Co. The Status of Science in the Philippines. Manila: Phoenix Press, 1957.

United Nations. Science and Technology for Development; Report on The UN Conference on the Application of Science and Technology for the Benefit of Less Developed Areas. Vols. VI and VII. New York: United Nations, 1963.

United Nations Educational, Scientific, and Cultural Organization. Manual for Surveying National and Scientific Technological Potential; Collection and Processing of Data, Management of "R & D" System; Science Policy Studies and Documents, No. 15. Paris: UNESCO, 1970.

_____. 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.

_____. National Science Policy and Organization of Research in the Philippines; Science Policy Studies and Documents, No. 22. Paris: UNESCO, 1970.

_____. Science Policy and Organization of Research in Belgium; Science Policy Studies and Documents, No. 1. Paris: UNESCO, 1965.

_____. 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.

_____. Scientists Abroad; A Study of the International Movement of Persons in Science and Technology. Paris: UNESCO, 1971.

United Nations Institute for Training and Research. The Brain Drain From Five Developing Countries -- Cameroon, Colombia, Lebanon, the Philippines, Trinidad and Tobago. Research Report No. 5; New York: UNITAR, 1971.

Van Hoek, F.J. The Migration of High Level Manpower from Developing Countries. The Hague/Paris: Mouton, 1970.

Varcoe, Ian. Organizing for Science in Britain: A Case Study. London: Oxford University Press, 1974.

Varela, Miguel Ma., et al. Scientists in the Philippines. Taguig, Rizal: National Science Development Board, 1974.

Vig, Norman J. Science and Technology in British Politics. Oxford: Pergamon Press, 1968.

Werskey, Gary. The Visible College. London: Allen Lane, 1978.

Worcester, Dean. The Philippines Past and Present. Vol. I. London: Mills and Boon, 1914.

World Bank. The Philippines; Priorities and Prospects for Development; A World Bank Country Economic Report. Washington, D.C.:The World Bank, 1976.

Ziman, John. The Force of Knowledge; The Scientific Dimension of Society. Cambridge: Cambridge University Press, 1976.

Zuckerman, Sir Solly. Beyond the Ivory Tower; the Frontiers of Public and Private Science. London: Weidenfeld and Nicholson, 1970.

II. ARTICLES

"A Re-examination of the Underemployment Problem in the Philippines," Journal of Philippine Statistics, Vol. 23, No. 3 (Third Quarter 1972), pp. ix-xxix.

"A Tribute to Filipino Ingenuity," Philippine Development, Vol. V, No. 2 (15 June 1977), pp. 25-28.

Albarracin, Narciso. "State of Private Higher Education," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 6-11.

"An Anatomy of the Unemployment Situation in the Philippines for the Decade 1956-1967," Journal of Philippine Statistics, Vol. 20, No. 2 (Second Quarter 1969), pp. vii-xiii.

Antiola, Soledad L. "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), pp. 5-11.

"Atoms for Progress," NEDA Development Digest, Vol. IV, No. 4 (15 July 1976), pp. 10-14.

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

Bantug, J.P. "The Beginnings of Medicine in the Philippines," in National Research Council of the Philippine Islands, Annual Report 1934-35, Bulletin No. 4 (Manila: February 1935), pp. 227-246.

Bautista, Esteban B. "The Truth About the Drug Industry in the Philippines," U.P. Newsletter, Vol. IV, Nos. 45-46 (15 and 22 November 1976).

Bello, Walden F., et al. "The Brain Drain in the Philippines," in Modernization and Its Impact in the Philippines, IV. Quezon City: Ateneo de Manila Press, 1969, pp. 93-142.

Ben-David, Joseph. "The Profession of Science and Its Powers," Minerva, Vol. X, No. 3 (July 1972), pp. 362-383.

Bernal, J.D. "Public Policy and Science," Political Quarterly, Vol. XXXVIII (January-March 1967), pp. 10-26.

Bhagwati, Jagdish. "The Brain Drain," International Social Science Journal, Vol. XXVIII, No. 4(1976), pp. 691-729.

_____ and Dellalfar, William. "The Brain Drain and Income Taxation," World Development, Vol. I, Nos. 1 & 2 (February 1973), pp. 94-101.

Boyd Monica. "Immigration Policies and Trends: A Comparison of Canada and the United States," Demography, Vol. XIII, No. 1 (February 1976), pp.83-104.

_____. "Oriental Immigration: The Experience of the Chinese, Japanese and Filipino Populations in the United States," International Migration Review, Vol. IV, No. 1 (Spring 1971), pp. 48-60.

_____. "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.

"Breakthroughs in Textile Research," NEDA Development Digest, Vol.III, No. 23 (30 April 1976), pp. 3-6.

Campos, Paulo C. "Employment Effects of a Rural Health Strategy for the Philippines," in Papers and Proceedings of the Workshop on Manpower and Human Resources; The Philippine Economic Journal, Number Twenty Three, Vol. XII, Nos. 1 & 2 (1973), pp. 72-100.

Caoili, Olivia C. "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, mimeo.

"Civil Service and Social Welfare Statistics," Journal of Philippine Statistics, Vol. 26, No. 3 (Third Quarter 1975), pp. 22-25.

Civil Service Commission, Board of Examiners. "Number of Selected Professionals Registered in the Philippines: Fiscal Year 1968 to Fiscal Year 1969," Journal of Philippine Statistics, Vol. 20, No. 4 (Fourth Quarter 1969), p. 31.

Cooper, Charles, "Science Policy and Technological Change in Underdeveloped Economies," World Development, Vol. 2, No. 3 (March 1974), pp. 55-64.

Cordero, Narciso. "Some Factors Affecting Research in the Basic Medical Sciences," U.P. Research Digest, Vol. VI, No. 1 (July 1966), pp. 7-11.

Corpuz, Onofre D. "Policies on Scientific Education and the 'Brain Drain'," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 257-263.

Cortes, Josefina R. "Brain Drain and Counter Brain Drain in the Philippines," in Papers and Proceedings of the Workshop on Manpower and Human Resources; The Philippine Economic Journal, Number Twenty Three, Vol. XII, Nos. 1 & 2 (1973), pp. 627-649.

_____. "Factors Associated with the Outflow of High Level Philippine Manpower," Philippine Sociological Review, Vol. 18, Nos. 3-4 (July-October 1970), pp. 159-166.

Cuyegkeng,Jose. "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, 4-10 October 1970], The Filipino Family Physician, Vol. IX, No. 4 (1971), pp. 20-33.

Dean, Genevieve and Macioti, Manfredo. "Scientific Institutions in China," Minerva, Vol. XI, No. 3 (July 1973), pp. 318-334.

"Dependence or Autonomy: UNCSTD's Hidden Agenda," Nature, Vol. 280 (16 August 1979), pp. 525-526,

Derbyshire, Robert C. "Warm Bodies in White Coats," Journal of the American Medical Association, Vol. 232, No. 10 (9 June 1975), pp. 1034-1035.

Dizon, Amado. "What Should Be the Role of Private Education," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 17-21.

"Education," Journal of Philippine Statistics, Vol. 22, No. 4 (Fourth Quarter 1971), pp. 30-32.

Egan, Robert L. "U.S. Citizens and Foreign Medical Schools," Journal of the American Medical Association, Vol. 232, No. 10 (9 June 1975), pp. 1028-1030.

Fabella, Armand V. "Transition, Change and Private Education," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 12-16.

"FAPE Marks 4th Year," FAPE Review, Vol. 3, No. 2 (March 1973), p. H.

Fernando, Antonio S. "The Philippine Medical Association," Journal of the Philippine Medical Association, Vol. XXIX, No. 5 (May 1953), pp. 223-226.

Ferriols, Vicente. "Early History of Veterinary Science in the Philippine Islands," in National Research Council of the Philippine Islands, Annual Report,1934-35, Bulletin No. 4 (Manila: February 1935), pp. 334-339.

Filner, Robert E. "The Roots of Political Activism in British Science," Bulletin of the Atomic Scientists, Vol. 32, No. 1 (January 1976), pp. 25-29.

Fortney, Judith. "Immigrant Professionals, A Brief Historical Survey," International Migration Review, Vol. VI, No. 1 (Spring 1972), pp.50-62.

Fox, Henry Frederick. "Primary Education in the Philippines, 1565-1863," Philippine Studies, Vol. 13 (1965), pp. 207-231.

Friedman, Sheldon. "The Effect of the US Immigration Act of 1965 on the Flow of Skilled Migrants from Less Developed Countries," World Development, Vol.1, No. 8 (August 1973), pp. 39-44.

Garcia, Bienvenido N. "Education and Training Requirements for Air and Water Pollution Abatement Program in the National Government," Science Review, Vol. XVI, No. 4 (July-August 1975), pp. 34-36.

Gardner, John, "The Gang of Four and Chinese Science," Bulletin of the Atomic Scientists, Vol. 33, No. 7 (September 1977), pp. 24-31.

Glaser, William A. and Habers, G. Christopher. "The Migration and Return of Professionals," International Migration Review, Vol. VIII, No. 2 (Summer 1974), pp. 227-244.

Goldblatt, Arlene, et al. "Licensure, Competence and Manpower Distribution," New England Journal of Medicine, Vol. 292, No. 3 (16 January 1975), pp. 137-141.

Gonzales, Andrew. "Taxation and Private Education," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 29-36.

Gonzales, Felix R. "Education and Training Requirements for Fisheries and Aquatic Resources Conservation," Science Review, Vol. XVI, No. 4 (July-August 1975), pp. 21-27.

Gonzales, Salvador R. "Higher Education, An Appraisal," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 303-319.

"Government Scholarships: Democratizing Education," Philippine Development, Vol. IV, No. 22 (15 April 1977), pp. 14-16.

Gresford, Guy B. and Châtel, Bertrand H. "Science and Technology in the United Nations," World Development, Vol. 2, No. 1 (January 1974), pp. 43-48.

Grubel, Herbert G. "Reflections on the Present State of the Brain Drain and a Suggested Remedy," Minerva, Vol. XIV, No. 2 (Summer 1976), pp. 209-224.

_____. "The Reduction of the Brain Drain: Problems and Policies," Minerva, Vol. VI, No. 4 (Summer 1968), pp. 541-558.

_____ and Scott, Anthony D. "The International Flow of Human Capital," American Economic Review; Papers and Proceedings, Vol. LVI, No. 2 (May 1966), pp. 268-274.

Gummett, Philip J. and Price, Geoffrey L. "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.

Gunning, Harry E. "The Lamontagne Report: A Simplistic Approach to a Complex Problem," Science Forum, Vol. 4, No. 2 (April 1971), pp. 7-8.

Gupta, M.L. "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), pp. 167-191.

_____. "The Philippine Regional Manpower, Employment and Income Situation," Manpower Philippines, Vol. I, No. 1 (September 1973), pp. 19-71.

"Harnessing the Cononut Tree's Potentials," Philippine Development, Vol. V, No. 2 (15 June 1977), pp. 21-24.

Hartendorp, A.V.H. "The Recovery of Philippine Science," The American Chamber of Commerce Journal, Vol. XXXIV, No. 4 (April 1958), pp. 154-159.

Hentges, Harriet. "The Korea Institute of Science and Technology: A Case Study in Repatriation," International Development Review/Focus, Vol. XVI, No. 3 (1974/3), pp. 27-30.

Hernandez, Dolores F. "The Progress of Science Education in the Philippines: 1963-1973," Professorial Chair Lecture Series, Monograph No. 6. Quezon City: University of the Philippines Press, 1975.

"Inventory of Philippine Resources," NEDA Development Digest, Vol. IV, No. 5 (31 July 1976), pp. 11-23.

Johnson, Harry G. "Economics of the 'Brain Drain': The Canadian Case," Minerva, Vol. III, No. 3 (Spring 1965), pp. 299-311.

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

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

Kidd, Charles V. "Letter to the Editor: The Economics of the 'Brain Drain'," Minerva, Vol. IV, No. 1 (Autumn 1965), pp. 105-107.

King, Alexander. "Towards a National Science Policy," Impact of Science on Society, Vol. XII, No. 3 (1962), pp. 157-175.

Lara, Hilario. "Development of Hygiene and Preventive Medicine (Public Health) in the Philippines," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 4 (Manila: February 1935), pp. 265-266.

Lesaca, Reynaldo M. "Pollution Control Legislation and Experience in a Developing Country: The Philippines," Journal of Developing Areas, Vol. 8, No. 4 (July 1974), pp. 537-556.

Lewis, Robert A. "Government and Technological Sciences in the Soviet Union: The Rise of the Academy of Sciences," Minerva, Vo. XV, No. 2 (Summer 1977), pp. 174-199.

"Linking Technology to Users," Philippine Development, Vol. V, No. 10 (15 October 1977), pp. 27-31.

Luria, Salvador E. "Goals of Science," Bulletin of the Atomic Scientists, Vol. 33, No. 5 (May 1977), pp. 29-33.

Magno, Melecio. "Progress of Physics," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 325-328.

Marquez, Cesar O. "Education and Training Requirements to Meet Environmental Problems in Infrastructure Development," Science Review, Vol. XVI, No. 5 (September-October 1975), pp. 7-13.

"Masagana 99: Bountiful As Ever," Philippine Development, Vol. IV, No. 10 (15 October 1976), pp. 18-20.

McCarthy, Florence E. "The Local Environment of Filipino Scientists," Philippine Sociological Review, Vol. 18, Nos. 3-4 (July-October 1970), pp. 169-173.

McGucken, William. "On Freedom and Planning in Science: The Society for Freedom in Science, 1940-46," Minerva, Vol. XVI, No. 1 (Spring 1978), pp. 42-72.

McRobie, George. "Intermediate Technology: Small is Successful," Third World Quarterly, Vol. I, No. 2 (April 1979), pp. 71-86.

Medina, Florencio A. "Overseas Training and the New Society," Science Review, Vol. XV, No. 4 (July-August 1974), pp. 6-9,

_____, et al. "Alcohol as Military Motor Fuel," in Pacific Science Association; Proceedings of the Eighth Pacific Science Congress, Vol. VI-B. Quezon City: National Research Council of the Philippines, 1963, pp. 165-203.

Mesthene, Emmanuel. "The Impact of Science on Public Policy," Public Administration Review, Vol. XXVII, No. 2 (June 1967), pp. 97-103.

Mick, Stephen S. "Foreign Medical Graduates," Scientific American, Vol. 232, No. 2 (February 1975), pp. 14-21.

Montgomery, John D. "Science Policy and Development Programs: Organizing Science for Government Action," World Development, Vol. 2, Nos. 4 & 5 (April-May 1974), pp. 63-69.

Moravcsik, Michael M. and Ziman, J.M. "Paradisia and Dominatia: Science and the Developing World," Foreign Affairs, Vol. 53, No. 4 (July 1975), pp. 699-724.

Moseley, Russell. "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.

"Moving Private Education Forward," Philippine Development, Vol. V, No. 11 (31 October 1977), pp. 9-14.

Muir, J. Douglas. "Letter to the Editor: The Reduction of the Brain Drain: Problems and Policies," Minerva, Vol. VII, No. 3 (Spring 1969), pp. 494-498.

Muriel, Amador. "Brain Drain in the Philippines: A Case Study," Bulletin of the Atomic Scientists, Vol. XXVI, No.7 (September 1970), pp. 38-39.

Myrdal, Gunnar. "The Transfer of Technology to Underdeveloped Countries," Scientific American, Vol. 231, No. 3 (September 1974), pp. 172-180.

_____. "Underdevelopment and the Evolutionary Imperative," Third World Quarterly, Vol. I, No. 2 (April 1979), pp. 24-42.

Niño, Milagrosa G. "Pharmaceutical Education in the Philippines," Unitas; revista de cultura y vida universitaria, Vol. 43 (June 1970), pp. 72-86.

Ocampo, Geminiano de. "Research and Medical Education," U.P. Research Digest, Vol. I, No. 3 (July 1962), pp. 21-23.

Pascual, Luis D. "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.

Pernia, Ernesto M. "The Question of the Brain Drain From the Philippines," International Migration Review, Vol. X, No. 1 (Spring 1976), pp.63-72.

Pilar, Nestor N., et al. "Social Development Policies and Programs in the Philippines: Focus on the Delivery of Health Services," SPAR Report No. 7. Manila: University of the Philippines, College of Public Administration, September 1976, mimeo.

"PMA; 46th Annual Meeting," Journal of the Philippine Medical Association, Vol. XXIX, No. 10 (October 1953), pp. 574-579.

Polanyi, J.C. "A Nation's Science and Technology," Bulletin of the Atomic Scientists, Vol. 32, No. 3 (March 1976), pp. 8-12.

Rangarao, B.V. "Science Policy: Role of Academic Societies," Science and Culture, Vol. 43, No. 5 (1977), pp. 194-200.

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

Reyes, Amelia B. "Education for National Development: Restructuring of Philippine Higher Education System," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 47-53.

Richter, Jr., Maurice N. "Chinese Science Policy; A Comparative Analysis," Bulletin of the Atomic Scientists, Vol. 32, No. 3 (March 1976), pp. 13-16.

Rizal, Leoncio Lopez. "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), pp. 146-182.

Rodriguez, Eulogio B. "Brief Observations on Science in the Philippines in the Pre-American Era," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 3 (Manila: February 1935), pp. 84-128.

Rosario, M.V. del. "Chemistry in the Pre-American Regime," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 5 (Manila: February 1935), pp. 359-367.

Rosca, Ninotchka, "The Oldest Corporation in the Philippines," The Fookien Times Yearbook (1975), pp. 158-163; 169.

Salcedo, Jr., Juan. "Industrial Research: An Imperative of Economic Progress," Science Review, Vol. X, No. 1 (January 1969), pp. 7-17.

_____. "Some Research Contributions of Filipino Scientists to the Basic Medical Sciences: A Panoramic Appraisal," Journal of the Philippine Medical Association, Vol. XXXIII, No. 11 (November 1957), pp. 807-813.

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

Schirmer, Daniel B. "The Philippine Bases: Bulwark of Dictatorship," The Progressive (April 1978) reprinted by Friends of the Filipino People, Washington, D.C.

Schumacher, John N. "One Hundred Years of Jesuit Scientists: The Manila Observatory 1865-1965," Philippine Studies, Vol. 13 (1965), pp. 258-286.

"Senator Lamontagne Replies to the Critics of the Senate Report," Science Forum, Vol. 4, No. 3 (June 1971), pp. 9-13.

Sioson, Federico M. "The Progress of Mathematics in the Philippines," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 320-324.

Smil, Vaclav. "Intermediate Energy Technology in China," Bulletin of the Atomic Scientists, Vol. 33, No. 2 (February 1977), pp. 25-31.

Soriano, Joventino. "The Progress of Biology," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 325-328.

Southwick, Thomas P. "'Brain Drain': Fewer Scientists Enter the U.S., More Scientists Seek to Leave," Science, Vol. 169 (7 August 1970), pp.565-566.

"Status of Manpower and Education Planning in the Philippines," The Philippine Economy Bulletin, Vol. III, No. 3 (January-February 1965), pp. 5-23.

Stauffer, Robert B. "Nation-Building in a Global Economy: The Role of the Multinational Corporation," Philippine Journal of Public Administration, Vol. XVI, No. 1 (January 1972), pp. 3-41.

_____. "The American Development Model: Hidden Agenda for the Third World," Philippine Journal of Public Administration, Vol. XXI, No 2 (April 1977), pp. 123-140.

_____. "The Marcos Coup in the Philippines," Monthly Review, Vol. 24, No. 11 (April 1973), pp. 19-27.

_____. "The Political Economy of Development: A Philippine Note," Philippine Journal of Public Administration, Vol. XVI, No. 2 (April 1972), pp. 129-146.

Sutherland, Sir Gordon. "The Brain Drain," The Political Quarterly, Vol. 38, No. 1 (January-March 1967), pp. 51-61.

Tan, Edita. "Causes of Unemployment of Educated Labor,"in Papers and Proceedings of the Workshop on Manpower and Human Resources; The Philippine Economic Journal, Number Twenty Three, Vol. XII, Nos. 1 & 2 (1973), pp. 607-626.

Thomas, Brinley, "The International Circulation of Human Capital," Minerva, Vol. 5, No. 4 (Summer 1967), pp. 479-506.

Torrevillas-Suarez, Domini. "Barefoot Doctors," Philippine Panorama, (29 August 1976), pp. 6-9.

"UNCSTD: What's to be Done? 14 Experts Comment," Nature, Vol. 280 (16 August 1979), pp. 527-532.

Valenzuela, Patrocinio. " A Historcal Review of Movements to Establish a Research Council of the Philippines," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 3 (Manila: February 1935), pp. 77-83.

_____. "Pharmaceutical Research in the Philippines," in National Research Council of the Philippine Islands, Annual Report, 1934-35, Bulletin No. 5 (Manila: February 1935), pp. 404-413.

Varela, Miguel Ma. "Private Higher Education: Some Observations," FAPE Review, Vol. 6, No. 1 (July 1975), pp. 44-46.

Velasco, Jose R. "A Critique of our Science Effort in the Last 25 Years," The Fookien Times Yearbook (1973), pp. 218, 220-221, 227.

_____. "The Status of Science in the Philippines," U.P. Research Digest, Vol. VI, No. 1 (July 1966), pp. 2-6.

Wideman, Bernard. "Health Care In Need of a Tonic," Far Eastern Economic Review, Vol. 86, No. 47 (29 November 1974), pp. 24-25.

Wilson, James A. and Gaston, Jerry. "Reflux from the 'Brain Drain'," Minerva, Vol. XII, No. 4 (October 1974), pp. 459-468.

Wojciechowski, Margot and Grove, J.W. "Looking Outward: The Changing Role of Scientific Societies,"Science Forum, Vol. 5, No. 3 (June 1972), pp. 29-31.

Yanong, Procopio U. "Medical Group Seeks Sharp Reduction of FMGs in the U.S.," Philippine Medical Association in Chicago Bulletin, Vol. XIV, No. 3 (May 1975), pp. 1,6-8.

Zamora, Estela L. "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: NSDB, 1975, pp. 5-10.

_____. "The Progress of Chemistry," in Science and Public Policy; Papers and Proceedings of the Conference on National Science and Technology Week, 10-16 July 1967. Manila: NSDB, 1968, pp. 329-331.

Zara, Gregorio Y. "Research in the Philippines: Accomplishments and Problems," The Philippine Economy Bulletin, Vol. V, No. 3 (1967), pp. 20-27.

III. DOCUMENTS, LAWS AND REPORTS

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.

_____. Constitution and By-Laws, 15 July 1967, mimeo.

Canada. Science Council of Canada. Policy Objectives for Basic Research in Canada; Report No. 18. Ottawa: Information Canada, September 1972.

_____. Senate. Special Committee headed by Sen. Maurice Lamontagne. A Science Policy for Canada; Vols. 1 & 2. Ottawa: Queen's Printer, 1970 and 1972.

Cebu Institute of Medicine. Bulletin of Information, 1976-77.

Education and Manpower Development in Asia. Friedrich-Ebert-Stiftung Regional Experts Workshop Series on Selected Problems of Social Development; Report I. Bangkok, Thailand: Friedrich-Ebert-Stiftung, [Federal Republic of Germany], 1972.

Federation of Accredited Professional Organizations of the Philippines. Constitution and By-Laws. Manila: August 1977, mimeo.

Manila Central University, Filemon D. Tanchoco Medical Foundation, Bulletin of Information, 1975.

1974 Philippine Physicians Directory of the U.S.A. Chicago: Privately published by the Philippine Medical Association in the U.S.A.,1974.

Parel, Cristina P. A Report on the Survey of Foreign-Trained Professionals and Their Employers in the Philippines. Quezon City: U.P.-NSDB Project No. 7303-ED, n.d., mimeo.

Philippine Association for the Advancement of Science. 25th Anniversary Convention Souvenir Program. Manila: 21-29 October 1976.

Philippine Islands. Census Office. Census of the Philippine Islands, 1918; Vol. IV, Part II. Manila: Bureau of Printing, 1921.

_____. National Research Council of the Philippine Islands. Annual Report, 1934-35, Bulletin Nos. 1-7. Manila: February 1935.

Philippine Islands. Philippine Commission. Act No. 74, creating a Department of Public Instruction in the Philippines; providing for the establishment of schools to give free primary education with English as the medium of instruction, 21 January 1901.

_____. Act No. 310, regulating the practice of medicine and surgery in the Philippines, 4 December 1901.

_____. Act No. 854, providing for the education of Filipino students in the United States, 26 August 1903.

_____. Act No. 1407, reorganizing the Bureau of Government Laboratories into a Bureau of Science, 26 October 1905.

_____. Act No. 1459, Corporation Law of 1906, 1 March 1906.

_____. Act No. 1632, providing scholarships in medicine for each of the provinces, 25 April 1907.

_____. Act No. 1870, creating the University of the Philippines, 18 June 1908.

Philippine Islands. Philippine Legislature. Act No. 2493, regulating the practice of medicine and nursing in the Philippines, 5 February 1915.

_____. Act No. 2706, Private School Law, 10 March 1917.

_____. Act No. 3162, authorizing a survey of the educational system of the Philippines, 8 March 1924.

_____. Act No. 4007, Reorganization Law of 1932, 5 December 1932.

_____. Act No. 4120, creating the National Research Council of the Philippines, 8 December 1933.

Philippine Statistical Association, Inc. Survey of Scientific and Technological Manpower in the Philippines: National Government Sector, 3 vols. Manila: NSDB, 1966, mimeo.

Philippines (Commonwealth). Commission of the Census. Census of the Philippines 1939; Vol. II Manila: Bureau of Printing, 1941.

_____. Commonwealth Act No. 180, repealing the Reorganization Law of 1932 and reestablishing the Office of Private Education, 13 November 1936.

_____. Commonwealth Act No. 589, Education Act of 1940, 19 August 1940.

_____. Constitution of the Philippines. 1935.

Philippines (Republic). Central Luzon State University. General Catalogue, 1974-75. Muñoz, Nueva Ecija: December 1975.

Philippines (Republic). Civil Service Commission, Board of Examiners for Chemical Engineering. Resolution No. 7, Series of 1968, amending the topic coverage and relative weights of the principal weights of the principal subjects in Board Examinations.

Philippines (Republic). Congress. Republic Act No. 184, regulating the practice of electrical engineering in the Philippines, 21 June 1947.

_____. Republic Act No. 318, regulating the practice of chemical engineering in the Philippines, 19 June 1948.

_____. Republic Act No. 382, regulating the practice of veterinary medicine and surgery in the Philippines, 18 June 1949.

_____. Republic Act No. 544, regulating the practice of civil engineering in the Philippines, 17 June 1950.

_____. Republic Act No. 545, regulating the practice of architecture in the Philippines, 17 June 1950.

_____. Republic Act No. 546, amending the Reorganization Law of 1932 and creating the Office of Boards of Examiners under the Civil Service Commission, 17 June 1950.

_____. Republic Act No. 754, regulating the practice of chemistry in the Philippines, 18 June 1952.

_____. Republic Act No. 770, creating the Science Foundation of the Philippines, 20 June 1952.

_____. Republic Act No. 766, creating the Commission on Volcanology, 20 June 1952.

_____. Republic Act No. 877, regulating the practice of nursing in the Philippines, 19 June 1953.

_____. Republic Act No. 997, creating the Government Survey and Reorganization Commission of 1954, 9 June 1954.

_____. Republic Act No. 1124, creating the Board of National Education, 16 June 1954.

_____. Republic Act No. 1364, regulating the practice of sanitary engineering in the Philippines, 18 June 1955.

_____. Republic Act No. 1387, creating the Mindanao State University, 18 June 1955.

_____. Republic Act No. 1606, creating a National Science Board, 23 August 1956.

_____. Republic Act No. 1998, regulating the practice of optometry in the Philippines, 22 June 1957.

_____. Republic Act No. 2067, Science Act of 1958, creating the National Science Development Board, 13 June 1958.

_____. Republic Act No. 2382, the Medical Act of 1959, 20 June 1959.

_____. Republic Act No. 2674, regulating the practice of dietetics in the Philippines, 18 June 1960.

_____. Republic Act No. 3661, creating the Philippine Science High School, 22 June 1963.

_____. Republic Act No. 3844, Agricultural Land Reform Code of 1963, 22 June 1963.

_____. Republic Act No. 3850, creating the Philippine Inventors Commission, 14 April 1964.

_____. Republic Act No. 3887, creating the University of the Philippines Natural Science Research Center, 18 June 1964.

_____. Republic Act No. 3927, regulating the practice of agricultural engineering in the Philippines, 18 June 1964.

_____. Republic Act No. 3931, creating the National Water and Air Pollution Control Commission, 18 June 1964.

_____. Republic Act No. 4056, providing government financial assistance to private medical schools, 18 June 1964.

_____. Republic Act No. 4059, creating the Philippine Coconut Research Institute, 18 June 1964.

_____. Republic Act No. 4067, converting the Central Luzon Agricultural College into the Central Luzon State University, 18 June 1964.

_____. Republic Act No. 4086, creating a Special Textile Research Fund, 18 June 1964.

_____. Republic Act No. 4090, providing for state scholarships for poor and deserving students and creating a State Scholarship Council to administer the program, 19 June 1964.

_____. Republic Act No. 4189, creating the West Visayas State College, 4 May 1965.

_____. Republic Act No. 4209, regulating the practice of geology in the Philippines, 19 June 1965.

_____. Republic Act No. 4224, amending certain sections of the Medical Act of 1959, 19 June 1965.

_____. Republic Act No. 4274, regulating the practice of mining engineering in the Philippines, 19 June 1965.

_____. Republic Act No. 4372, amending Republic Act No. 1124, creating the Board of National Education, 19 June 1965.

_____. Republic Act No. 4374, regulating the practice of geodetic engineering in the Philippines, 19 June 1965.

_____. Republic Act No.4419, regulating the practice of dentistry in the Philippines, 19 June 1965.

_____. Republic Act No. 4565, regulating the practice of naval architecture and marine engineering in the Philippines, 19 June 1965.

_____. Republic Act No. 4593, establishing the Philippine Eye Research Institute in the University of the Philippines, 19 June 1965.

_____. Republic Act No. 4704, amending certain sections of Republic Act No. 877, regulating the practice of nursing in the Philippines, 18 June 1966.

_____. Republic Act No. 4724, creating the Metals Industry Research and Development Center, 18 June 1966.

_____. Republic Act No. 5163, creating a Health Science Center in the University of the Philippines, 17 June 1967.

_____. Republic Act No. 5197, regulating the practice of sugar technology in the Philippines, 27 April 1968.

_____. Republic Act No. 5336, regulating the practice of mechanical engineering in the Philippines, 15 June 1968.

_____. Republic Act No. 5435, creating the Commission on Reorganization, 9 September 1968.

_____. Republic Act No. 5448, creating a Special Science Fund, 25 September 1968.

_____. Republic Act No. 5470, amending Republic Act No. 5448, creating a Special Science Fund, 30 May 1969.

_____. Republic Act No. 5526, creating the Forest Products Research and Industries Development Commission, 21 June 1969.

_____. Republic Act No. 5527, Philippine Medical Technology Act of 1969, 21 June 1969.

_____. Republic Act No. 5677, amending Republic Act No. 4274, regulating the practice of mining engineering in the Philippines, 21 June 1969.

_____. Republic Act No. 5680, creating the Board of Examiners for Physical and Occupational Therapists, 21 June 1969.

_____. Republic Act No. 5734, Electronics and Communications Engineering Act of the Philippines, 21 June 1969.

_____. Republic Act No. 5921, regulating the practice of pharmacy and setting standards of pharmaceutical education in the Philippines, 23 June 1969.

_____. Republic Act No. 5946, amending the Medical Act of 1959, reducing the five-year medical curriculum by removing the fifth year internship requirement for the Doctor of Medicine degree, 23 June 1969.

_____. Republic Act No. 6055, providing for the conversion of educational institutions from stock corporations to nonprofit foundations, 4 August 1969.

_____. Republic Act No. 6111, establishing the Philippine Medical Care Plan and creating the Philippine Medical Care Commission, 4 August 1969.

_____. Republic Act No. 6138, amending Republic Act No. 5527, Philippine Medical Technology Act of 1969, 31 August 1970.

_____. Republic Act No. 6239, regulating the practice of the forestry profession in the Philippines, 19 June 1971.

Philippines (Republic). Congress. Senate. Committee on Education, Higher Education Research Council. Higher Education in the Philippines in 1970-71; Vol. I. Manila: 1972, mimeo.

_____. "Report of the Consultant Committee on Medicine," 1970, mimeo.

Philippines (Republic). Congress. Senate. Committee on Scientific Advancement. Report on the Problems of Science in the Philippines. Manila: NSDB, 1963.

Philippines (Republic). Constitution of the Republic of the Philippines, 1973. Manila: NEDA, 1975.

Philippines (Republic). Department of Education. Annual Report, 1964-65. Manila: 1965, mimeo.

_____. Annual Report, 1968-69. Manila: 1969, mimeo.

_____. Corpuz, Onofre D. "Education in the Seventies." Manila: November 1967, typescript.

_____. Board of Medical Education. Annual Report, Fiscal Year 1968-69. Manila: 1969, mimeo.

Philippines (Republic). Department of Education. Board of National Education. General Educational Policies; A Report of the Board of National Education, 1958. Quezon City: Bookman, 1960.

_____. General Policies on Education, 1967-72. Manila: BNE, 1972.

_____. School Statistics, School Years 1966-67 to 1971-72, mimeo.

Philippines (Republic). Department of Education. Office of the Secretary. "Programs Being Undertaken in Relation to National Development and the Four-Year Plan." Manila: April 1971, mimeo.

Philippines (Republic). Department of Education and Culture. Department Order, Series 1977, "Creating the Technical Panel for Engineering Education and Defining its Functions and Responsibilities," August 1977, mimeo.

_____. Revised Five-Year Civil, Electrical and Mechanical Engineering Curriculums, 1973-74. Manila: 1973, mimeo.

Philippines (Republic). Department of Education and Culture. Educational Development Projects Implementing Task Force (EDPITAF). Annual Report, 1974-75. Manila: 1975, mimeo.

_____. Annual Report, 1975-76. Manila: 1976, mimeo.

_____. Annual Report, 1976. Manila: 1977, mimeo.

_____. "Engineering Education Project"; Summary. Manila:1976,mimeo.

Philippines (Republic). Department of Education and Culture. Planning Service, Project Development and Evaluation Division, "Public and Private Universities/Colleges by Region as of 1975," December 1975, mimeo.

Philippines (Republic). Department of Labor. Interim Manpower Plan, FY 1974-1977. Quezon City: National Manpower and Youth Council, 1974.

Philippines (Republic). Department of Natural Resources. Forest Research Institute. FORI Annual Report, 1976. College, Laguna: January 1977.

Philippines (Republic). Department of Public Information. The Economy of the Philippines; Philippine Briefings, No. 2. Manila: January 1975.

_____. The New Society of the Philippines; Philippine Briefings, No. 1. Manila: January 1975.

Philippines (Republic). Isabela State College of Agriculture. Ten-Year Development Plan, 1976-77 to 1985-86. Echague: 1976, mimeo.

Philippines (Republic). Mindanao State University. University Catalogue, 1974-75. Marawi City: 1974.

_____. Fifth Annual Report, 1965-66. Marawi City: June 1966.

Philippines (Republic). National Agricultural Research Survey, Technical Panel. The Philippine Agricultural Research System; Vol. I, Evaluation and Recommendations. Manila: 1971, mimeo.

Philippines (Republic). National Census and Statistics Office. "Labor Force: August 1975," National Sample Survey of Households Bulletin, Series No. 46. Manila: July 1976.

_____. 1975 Integrated Census of the Population and its Economic Activities: Population, Metropolitan Manila. Manila: November 1975.

_____. Philippines, 1970 Census of Population and Housing, National Summary; Vol. II. Manila: 1972.

Philippines (Republic). National Economic and Development Authority. Four-Year Development Plan, FY 1974-1977. Manila: 1973.

_____. Long-Term and Five-Year (1978-82) Development Plans; Draft Summary. Manila: 1977.

_____. 1977 Philippine Statistical Yearbook. Manila: March 1977.

_____. Report on the Philippine Economy, 1976. Manila: 1977.

_____. Agriculture Staff. Philippine Agriculture in the Last Twenty-Five Years. Manila: 1975.

Philippines (Republic). National Manpower and Youth Council. 1974-75 Fiscal Year Report. Quezon City: 1975.

Philippines (Republic). National Research Council of the Philippines. Annual Report, January-December 1975. Taguig, Rizal: 1976, mimeo.

_____. Annual Report, January-December 1976. Taguig, Rizal: February 1977, mimeo.

Philippines (Republic). National Science Development Board. Manila: National Media Production Center, 1976.

Philippines (Republic). National Science Development Board. Annual Report, FY 1969-70. Quezon City: December 1970.

_____. Annual Report, FY 1971-72. Taguig, Rizal: 1972.

_____. Annual Report, Fiscal Year 1973. Taguig, Rizal: 1973, mimeo.

_____. Board of Governors. "Policy Instructions No. 5.3: Overseas and Local Training for Personnel of the NSDB;" Resolution No. NSDB/SM 36, R.6, 18 September 1970, mimeo.

_____. Board of Governors. 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.

_____. Board of Governors. Resolution 246--R.3, establishing the Philippine Textile Research Institute, 3 January 1967.

_____. Board of Governors. 13th S/M, authorizing the Synergistic Consultants Inc. to undertake a science policy study, 19 July 1976, mimeo.

_____. Board of Governors. Ad Hoc Committee on National Science Policy. "Proposed National Science Policy of the Philippines," 7 October 1974, mimeo.

_____. Policy Instructions (Manual). Taguig, Rizal:n.d., mimeo.

_____. Report on the Recently Concluded NSDB-NEDA Workshop on the Role of Science and Technology in National Development. 9 October 1975, mimeo.

_____. Rules of Procedure of the Board of Governors of the National Science Development Board. Manila: 1975.

_____. Science and Technology: Key to National Progress. Manila: 1972.

_____. Seminar-Workshop on Science Policy; Proceedings and Summary Report. Bicutan, Metro Manila: 1977, mimeo.

_____. Special Project No. 7306 OT, establishing a Center for Scientific and Technological Organizations, 23 April 1973.

_____. Survey of Scientific and Technological Manpower in the Philippines: Local Government. 2 Vols. Manila: 1969, mimeo.

Philippines (Republic). National Science Development Board. Commission on Volcanology. 23rd Annual Report, July 1, 1975-June 30, 1976. Quezon City: 1976, mimeo.

Philippines (Republic). NSDB. Food and Nutrition Research Institute. Annual Report July 1, 1975-June 30, 1976. Manila: 1976, mimeo.

_____. Report of Activities, July 1, 1976-December 31, 1976. Manila: 1977, mimeo.

Philippines (Republic). NSDB. Forest Products Research and Industries Development Commission. Annual Report, Fiscal Year 1973-74. College, Laguna: August 1974, mimeo.

_____. Annual Report, Fiscal Year 1974-75. College, Laguna: August 1975, mimeo.

_____. Annual Report of Accomplishments, July 1975-June 1976. College, Laguna: August 1976.

Philippines (Republic). NSDB. National Institute of Science and Technology. Annual Report for Fiscal Year 1973-74. Manila: July 1974.

_____. Annual Report, 1974-75. Manila: July 1975.

_____. Report, July 1975-December 1976. Manila: December 1976, mimeo.

Philippines (Republic). NSDB-Department of Tourism. Balik-Scientist Program, Annual Report, 1976. Taguig, Metro Manila: 1976, mimeo.

_____. Balik-Scientist Program, Second Anniversary, Report. Taguig, Metro Manila: July 1977.

_____. "Rules and Regulations Implementing Presidential Decree No. 819," implementing the law establishing the Balik-Scientist Program, October 1975, mimeo.

Philippines (Republic). NSDB and National Pollution Control Commission. Workshop on Education and Training Needs for Philippine Environmental Programs. Manila: 27-31 May 1974.

Philippines (Republic). Office of the President. Executive Order No. 94, reorganizing the Bureau of Science and creating the Institute of Nutrition, 4 October 1947.

_____. Executive Order No. 156, creating the Fund for Assistance to Private Education, 5 November 1968.

_____. Letter of Instruction No. 377, requiring all successful examinees of medical and nursing board examinations to present to the Professional Regulation Commission a duly signed certificate of completion of six months rural training program as a prerequisite to their registration with the Commission, 3 March 1976.

_____. Presidential Decree No. 1, authorizing the implementation of the Integrated Reorganization Plan of the Executive Branch of the Philippine Government, 24 September 1972.

_____. Presidential Decree No. 6-A, authorizing the undertaking of educational development projects to rationalize the educational system; creating the Educational Development Projects Implementing Task Force, 29 September 1972.

_____. Presidential Decree No. 48, creating the Philippine Council for Agriculture Research (PCAR), 10 November 1972.

_____. Presidential Decree No. 58, creating the University of the Philippines System, 20 November 1972.

_____. Presidential Decree No. 146, requiring students to pass the National College Entrance Examinations before admission to post-secondary courses which need four years to complete, 9 March 1973.

_____. Presidential Decree No. 187, providing for the conversion of existing English measures and customary units to metric equivalents effective in January 1975, 10 May 1973.

_____. Presidential Decree No. 223, creating the Professional Regulation Commission and prescribing its powers and functions, 22 June 1973.

_____. Presidential Decree No. 233, creating the Food and Nutrition Research Institute as a separate agency under the National Science Development Board, 1 July 1973.

_____. Presidental Decree No. 365, amending Presidential Decree No. 6-A, authorizing the undertaking of educational development projects, 3 January 1974.

_____. Presidential Decree No. 541, allowing former Filipino professionals to practice their respective professions in the Philippines, 20 August 1974.

_____. Presidential Decree No. 606, transferring the Philippine Atomic Energy Commission from the National Science Development Board to the Office of the President, 14 December 1974.

_____. Presidential Decree No. 607, creating the Forest Research Institute in the Department of Natural Resources, 18 December 1974.

_____. Presidential Decree No. 657, amending Presidential Decree No. 223, creating the Professional Regulation Commission, 19 February 1975.

_____. Presidential Decree No. 819, establishing the Balik-Scientist Program, 24 October 1975.

_____. Presidential Decree No. 839, placing the Professional Regulation Commission under the administrative supervision of the Civil Service Commission, 11 December 1975.

_____. Presidential Decree No. 864, extending the functions of PCAR to include mines research and converting it into the Philippine Council for Agriculture and Resources Research (PCARR), 29 December 1975.

_____. Presidential Decree No. 910, creating the Energy Development Board, 22 March 1976.

_____. Presidential Decree No. 984, replacing the National Water and Air Pollution Control Commission with the National Pollution Control Commission, 18 August 1976.

_____. Presidential Decree No. 997, conferring civil service eligibility on scientific and technological specialists, 16 September 1976.

_____. Presidential Decree No. 1003-A, creating the National Academy of Science and Technology, 22 September 1976.

_____. Presidential Decree No. 1096, National Building Code, 19 February 1977.

_____. Presidential Decree No. 1097, creating the Technology Resource Center, 23 February 1977.

_____. Presidential Decree No. 1396, creating the Department of Human Settlements, 2 June 1978.

Philippines (Republic). Office of the President. Budget Commission. National Government Budget, January 1-December 31, 1977. Manila: 1977.

Philippines (Republic). Office of the President. Philippine Atomic Energy Commission. Annual Report, 1976. Quezon City: February 1977, mimeo.

Philippines (Republic). Philippine Council for Agriculture and Resources Research. Annual Report, CY 1975. Los Baños, Laguna: November 1976, mimeo.

_____. New Directions in Research. Los Baños, Laguna: 1976.

Philippines (Republic). Philippine Science High School. Report, 1976-77. Quezon City: 1977, mimeo.

Philippines (Republic). 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.

Philippines (Republic). Presidential Commission to Survey Philippine Education (PCSPE). Education for National Development: New Patterns, New Directions; Philippine Education Survey Report, Vol. 2. Manila: December 1970.

_____. PCSPE. A Report on Educational Finance in the Philippines. Manila: 1970, mimeo.

_____. PCSPE. Special Area Group for Higher Education. A Report on Higher Education in the Philippines. Manila: 1970, mimeo.

_____. PCSPE, Special Area Group on Science Education. Report of the Special Area Group on Science Education. Manila: May 1971, mimeo.

_____. PCSPE, Special Area Group for Vocational-Technical Education. Vocational-Technical Education in the Philippines. Quezon City: National Manpower and Youth Council, 1974.

Philippines (Republic). Presidential Study Committee on State Higher Education, Technical Staff. Towards the Integration of Higher Education in the Philippines; Preliminary Report. Manila: 1975, mimeo.

Philippines (Republic). Professional Regulation Commission. Professional Regulation Code, Integrating the different professional licensing and regulatory laws in the country; a draft proposal. Manila: August 1977, mimeo.

_____. "Rules and Regulations Governing the Regulation and Practice of Professionals," in Official Gazette, Vol. 71, No. 4 (27 January 1975), pp. 407-416.

Philippines (Republic). Science Foundation of the Philippines. Annual Report of the President, Calendar Year 1975. Taguig, Rizal: January 1976, mimeo.

Philippines (Republic). University of the Philippines. College Cebu, Center for Regional Development Operations. U.P. College Cebu Marine Sciences Center: A Proposal. Lahug, Cebu City: March 1977, mimeo.

_____. U.P. College of Engineering, Catalogue, 1976-77. Quezon City: 1976.

_____. Office of the President. "The U.P. System and the Future: A Perspective Development Plan." Quezon City: February 1976, mimeo.

_____. Statistical Center. Survey of Scientific and Technological Manpower in the Philippines: Educational Institutions and Non-Profit Organizations, 2 Vols. Manila: National Science Development Board - U.P. Statistical Center, 1968, mimeo.

_____. Statistical Center. Survey of Scientific and Technological Manpower in the Philippines: Private Industry. 2 Vols. Manila: NSDB-U.P. Statistical Center, 1967, mimeo.

Philippines (Republic). West Visayas State College. Bulletin of Information, 1976. Iloilo City: 1976.

Saint Louis University. General Bulletin, 1976-77. Baguio City: 1976.

Synergistic Consultants, Inc. Management Review of the National Science Development Board; Final Report and Addendum to Final Report. Quezon City: Center for Development Studies, Inc., 1977, mimeo.

_____. Science Policy Studies; Final Report. Manila: March 1977, mimeo.

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.

United Nations Economic and Social Council. Outflow of Trained Personnel from Developing and Developed Countries; Report of the Secretary General. New York: 1970.

United States. Bureau of the Census. Census of the Philippine Islands, 1903; Vols. II and III. Washington, D.C.: Government Printing Office, 1905.

United States. Library of Congress, Congressional Research Service, Foreign Affairs Division. Brain Drain: A Study of the Persistent Issue of International Scientific Mobility; 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.

University of San Agustin, General Catalogue, 1976-77. Iloilo City: 1976.

University of San Carlos. Information Bulletin, 1976. Cebu City: 1976.

_____. Report, 1976. Cebu City: 1976.

University of Santo Tomas. College of Science. Prospectus, 1977-78. Manila: 1977.

_____. Graduate School. Prospectus, 1977-78. Manila: 1977.

IV. NEWSPAPERS

"American, Asian Educators Applaud UPLB-SEARCA-IRRI Development Efforts," The UPLB Horizon, Vol. III, No. 8 (August 1975), p. 1.

Ayo, A.G., "Alkoline Anyone? An Energy Supplement," U.P. Newsletter, Vol. V, No. 3 (24 January 1977), pp. 1,2.

"Benefits for all Scientists Urged," Bulletin Today, 12 December 1976, pp.1, 16.

"Biotechnology, Microbiology Institutes Established at U.P. at Los Baños," New Horizons, Vol. I, No. 3 (November/December 1979), pp. 1,2.

"Brain Drain Holds Back Rural Health," Times Journal, 21 January 1976, p. 5.

"Buck Proposed Engineering Law," Bulletin Today, 26 July 1977, p. 30.

"Cite Moves to Cut Down 'Brain Drain'," Bulletin Today, 23 June 1977, pp. 1,4.

"Crop Science Journal Gets PCARR Support," Monitor, Vol. IV, No. 1, (January 1976), p. 16.

Editorial, Bulletin Today, 7 November 1976, p. 4.

"Eight PCARR Scholars Finish Studies," Monitor, Vol. IV, No. 12 (December 1976), pp. 11, 2.

"Endorses Medical Progress," Bulletin Today, 17 April 1977, p. 24.

"FM Confers Jose Rizal Pro Patria Award to 8 UP at Los Baños Faculty Members," The UPLB Horizon, Vol. IV, No. 9 (September-October 1976), pp. 1,2.

"FM Expands PCAR Scope; PCAR is now PCARR," Monitor, Vol. IV, No. 1 (January 1976), pp. 1,2.

"Government Acts to Win Back Filipino Scientists Abroad," Philippine News (Chicago, Illinois) 18-24 July 1974, p. 1.

"Gov't Doctors Resign; Health Crisis Hits Zambo," Bulletin Today, 22 June 1976, p. 31.

"Government Policy on Outflow of Doctors, Nurses Set," Bulletin Today, 2 November 1975, pp. 1, 11.

"Health Care in the Philippines," The Philippine Liberation Courier, June 1980, pp. 3-5.

"How AGCEP Started," Bulletin Today, 16 June 1977, p. 16.

Lara, Ben T., "It's Time to Regulate Structural Engineering," Bulletin Today, 31 August 1977, p. 7.

"List Professional Organizations," Bulletin Today, 10 September 1976, p. 12.

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

"Manila Medical Society," Editorial, Bulletin Today, 9 July 1977, p. 6.

"Massive Research Manpower Development Program in Full Swing," Monitor, Vol. IV, No. 6 (June 1976), pp. 1,2.

"Medical 'Brain Drain' Won't Affect RP Health Program?" Bulletin Today, 20 September 1975, p. 24.

"The Medical Course," Editorial, Bulletin Today, 7 November 1976, p. 6.

"More UPLB Grad Students get PCARR Support," Monitor, Vol. IV, No. 8 (August 1976), p. 15.

"NSDB Bares Technology Program in Rural Areas," Bulletin Today, 27 December 1976, p. 1.

"NSDB Head Cites Key to Rural Uplift," Bulletin Today, 14 March 1977, p. 31.

"NSDB Thesis Grants Open," U.P. Newsletter, Vol. V, No. 4 (31 January 1977), p. 7.

"New Auditing Manual to Ease Research Operations," Monitor, Vol. V, No. 7 (July 1977), pp. 1,7.

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

"₱3-M Science, Technology Complex to Be Constructed," Philippines Daily Express, 13 May 1974, p. 15.

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

"Plan Seminar on Fire Safety," Bulletin Today, 13 May 1976, p. 24.

"President Orders Review of Policies on Science," Philippines Daily Express, 12 July 1974, pp. 1,2.

"Professional Regulation Commission Celebrates 4th Anniversary Today," Bulletin Today, 22 June 1977, p. 12.

"To Cite Top Professionals," Bulletin Today, 22 June 1977, p. 40.

"21 Qualify as INTAPS Scholars," New Horizons,Vol. I, No. 1 (September 1979), p. 11.

"Regulate Structural Engineering -- Kalalo," Bulletin Today, 6 July 1977, p. 17.

"Review Classes for Engineers," Bulletin Today, 17 July 1977, p. 16.

Rous, Alberto, "Tacloban Experiment: School Trains Rural Doctors," Times Journal, 16 August 1976, pp. 1,8.

"RP Science Development," Bulletin Today, 31 December 1976, p. 10.

"Science Education," Editorial, Times Journal, 4 April 1977, p. 4.

"Seek Remedy to Multinational Ills in RP," U.P. Newsletter, Vol. V, No. 4 (31 January 1977), pp. 1,8.

"Seminar on Building Code," Bulletin Today, 31 July 1977, p. 5.

"Shortening of RP Medical Course Urged," Bulletin Today, 6 November 1976, p. 1.

"Solving the Brain Drain," Editorial, Philippines Daily Express, 24 June 1977, p. 4.

"Symposia on Nuclear, Geothermal and Solar Energy," Bulletin Today, 24 November 1976, p. 39.

"The Bases Agreement -- A Commentary," Philippine Liberation Courier, Vol. III, No. 1 (26 January 1979), pp. 4-5.

"To Grant Eligibility to Filipino Scientists," Bulletin Today, 1 January 1977, p. 17.

"2,600 Doctors May Lose Out on Medicare," Bulletin Today, 8 August 1976, p. 24.

"Unilab Assists PPS Realize its Objectives," Bulletin Today, 3 May 1976, p. 29.

"United Lab Support PMWA Projects," Bulletin Today, 22 April 1976, pp. 27,28.

"UPLB's Medicinal Plants Project," UPLB Newsletter, 30 April 1980, p. 4.

"Urge to Limit Foreign Royalties," Bulletin Today, 15 February 1977, p. 24.

V. UNPUBLISHED MATERIALS

Filner, Robert E. "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.

Gasmen, Sergio S. "Comprehensive Community Health Program," paper read at the National Seminar on Educational Innovation for Development, Manila, 5-6 January 1976.

Gutierrez, Eduardo V. "The Revision of the Curriculum Requirements for Chemical Engineering," a report submitted to the Bureau of Private Schools, Department of Education, 19 March 1970.

Legarda, Benito 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.

Madamba, Joseph C. "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, November 1976.

McCarthy, Florence E. "Third Cultural Networks of Philippine Physical, Life,and Social Scientists." Ph.D. thesis submitted to the Department of Sociology, Michigan State University, East Lansing, 1972.

Mejia-Raymundo, Corazon G. "The Characteristics of and Extent of Unemployment Among the Philippine High-Level Manpower." Master's thesis submitted to the Population Institute, University of the Philippines, 1972.

Miranda, B.T. "Advancement of Science in the New Society," paper prepared for the Annual Symposium of the Philippine Association for the Advancement of Science, Manila, 29 January 1974.

Opeña, Lilia Campo. "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.

Ortigas, Gaston Z. "The Utilization and Development of Engineering Graduates in Philippine Industry." Ph.D. dissertation, Harvard University, Cambridge, Mass., 1974.

Stauffer, Robert B. "Philippine Martial Law: The Political Economy of Recolonization," paper presented at a meeting of the Association for Asian Studies, Boston, 3 April 1974.

_____. "The Political Economy of a Coup: Transnational Linkages and Philippine Political Response," paper prepared for the University of Hawaii, Honolulu, n.d.

Tan, Edita A. "Philippine Market for Educated Labor"; NSDB Project No. 2.135: National Science Policy of the Philippines, Manila, 1969.

VI. LIST OF INTERVIEWEES

Mrs. Gerarda Abanil, Chairman, Department of Biological Sciences, Xavier University, Cagayan de Oro City, 19 April 1977.

Dr. Leopoldo V. Abis, Associate Dean, College of Engineering, University of the Philippines, Quezon City, 22 July 1977.

Mr. Manuel Acero, Assistant Science Field Officer, Region No. 8, National Science Development Board, Cagayan de Oro City, 19 April 1977.

Mr. Pedro Afable, Vice-Chairman and Executive Director, NSDB, Bicutan, Metro Manila, 30 March 1977.

Dr. Narciso Albarracin, Undersecretary, Department of Education and Culture, Manila, 24 March 1977.

Mrs. Linda P. Alonzo, Head, Zoology Section, Department of Biological Sciences, Central Luzon State University, Muñoz, Nueva Ecija, 9 May 1977.

Mr. Espiritu S. Altis, Dean, College of Agriculture, Central Philippine University, Iloilo City, 26 April 1977.

Rev. Fr. Jeronimo Alvarez, O.S.A., Vice Rector and Dean, College of Liberal Arts, University of San Agustin, Iloilo City, 25 April 1977.

Mr. Virgilio T. Andres, Assistant Chairman, Department of Mathematics and Physics, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

Mrs. Soledad Antiola, Executive Director, Science Foundation of the Philippines, NSDB, Metro Manila, 1 March 1977.

Mr. Antonio Aquino, Chairman, Vocational-Technical Department, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

Mr. Teofilo S. Ariz, Director of Academic Program, Central Luzon State University, Muñoz, Nueva Ecija, 26 May 1977.

Dr. Cleofe Bacungan, Director, Philippine Science High School, Quezon City 25 March 1977.

Mrs. Pilar C. Baquiran, Chairman, Department of Chemistry, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

Rev. Fr. Emeterio J. Barcelon, S.J., President, Ateneo de Davao College, Davao City, 21 April 1977.

Dr. Dante Benigno [past President of the Philippine Phytopathological Society] and Chairman, Department of Plant Pathology, University of the Philippines at Los Baños, Laguna, 26 July 1977.

Dr. Felipe Cachola, President, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

Mr. Augusto P. Cammayo, Chairman, Department of Biological Sciences, Isabela State College of Agriculture, Echague, Isabela, 7 May 1977.

Dr. Filomena F. Campos, Director of Research, Central Luzon State University, Muñoz, Nueva Ecija, 26 May 1977.

Dr. Juan T. Carlos, Chairman,Department of Horticulture, U.P. at Los Baños, Laguna, 16 August 1977.

Dr. Nilda Causing, Director of Research, West Visayas State College, Iloilo City, 25 April 1977.

Dr. Igmidio T. Corpuz, Chairman, Department of Soil Science, U.P. at Los Baños, Laguna, 26 July 1977.

Mrs. Conchita M. Cruz, Dean, College of Arts and Sciences, Central Luzon State University, Muñoz, Nueva Ecija, 26 May 1977.

Dr. Juliana Dacayo, Chairman, Department of Soil Science, Central Luzon State University, Muñoz, Nueva Ecija, 27 May 1977.

Mr. Uldarico Dumdum, Dean, College of Engineering, University of Mindanao, Davao City, 21 April 1977.

Mrs. Felicisima V. Eugenio, Secretariat, Board of National Education, Department of Education and Culture, Manila, 25 June 1976.

Dr. Thomas Flores, Director, Technical Services Division, Philippine Council for Agriculture and Resources Research, Los Baños, Laguna, 29 March 1977.

Dr. Bernardo P. Gabriel, President, Philippine Association of Entomologists and Chairman, Department of Entomology, U.P. at Los Baños, Laguna, 18 July 1977.

Dr. Ester Albano Garcia, Chairman, Department of Chemistry, University of the Philippines, Quezon City, 22 July 1977.

Dr. Severino Gervacio, Chairman, Department of Mathematics, Statistics and Physics U.P. at Los Baños, Laguna, 18 July 1977.

Rev. Fr. Francisco Glover, S.J., Chairman, Division of Engineering and Physics, Ateneo de Davao College, Davao City, 21 April 1977.

Mr. Martin M. Guantes, Chairman, Department of Crop Protection, Central Luzon State University, Muñoz, Nueva Ecija, 27 May 1977.

Dr. Rafael D. Guerrero III, Dean, College of Inland Fisheries and Chairman, Department of Aquatic Biology, Central Luzon State University, Muñoz, Nueva Ecija, 27 May 1977.

Mrs. Ma. Patrocinio E. de Guzman, President, Dietetic Association of the Philippines, Manila, 4 August 1977.

Rev. Fr. Ernesto O. Javier, S.J., Rector and Vice-President, Xavier University, Cagayan de Oro City, 19 April 1977.

Mr. Silvestre Javier, Project Director, Center for Scientific and Technological Organizations and Chief, International Relations Division, NSDB, Metro Manila, 20 July 1977.

Dr. Cesar Jesena, Coordinator, Balik-Scientist Program and Vice President for External Affairs, Visayas State College of Agriculture, Los Baños, Laguna, 26 February 1976.

Dr. Quintin Kintanar, Science Research Chief, Biological Research Center, National Institute of Science and Technology, Manila, 10 March 1977.

Mrs. Aurora de Leon, Executive Secretary, University of Mindanao, Davao City, 22 April 1977.

Dr. Cesar Madamba, Chairman, Department of Zoology, U.P. at Los Baños, Laguna, 25 July 1977.

Dr. Joseph C. Madamba, Director-General, PCARR, Los Baños, Laguna, 13 May 1977.

Dr. Melecio Magno, Chairman, NSDB, Metro Manila, 16 and 23 March 1977.

Rev. Fr. William F. Masterson, S.J., Dean, College of Agriculture and Director, Southeast Asia Rural Social Leadership Institute, Xavier University, Cagayan de Oro City, 20 April 1977.

Brig. Gen. (Ret.) Florencio A. Medina, Chairman, National Research Council of the Philippines, Metro Manila, 8 March 1977;1 and 13 April 1977.

Dr. Bonifaco T. Mercado, Chairman, Department of Botany, U.P. at Los Baños, Laguna, 18 July 1977.

Dr. Vicente G. Momongan, President, Society for the Advancement of Research and Chairman, Department of Animal Science, U.P. at Los Baños, Laguna, 19 July 1977.

Mr. Teofilo H. Montemayor, Coordinator for State Universities and Colleges, Department of Education and Culture, Manila, 4 March 1977.

Mrs. Efigenia Occena, Vice President for Educational Services, University of Mindanao, Davao City, 22 April 1977.

Mr. Dionisio O. Orden, Chairman, Department of Animal Science, Central Luzon State University, Muñoz, Nueva Ecija, 25 May 1977.

Mr. Francis L. Padilla, Dean, College of Technology, University of San Agustin, Iloilo City, 25 April 1977.

Dr. William G. Padolina, Chairman, Department of Chemistry, U.P. at Los Baños, Laguna, 19 July 1977.

Dr. Maria Celia Palma, Dean, College of Arts and Sciences, West Visayas State College, Iloilo City, 25 April 1977.

Mr. Agapito Perez, Chief Coordinator, Balik-Scientist Program, NSDB, Metro Manila, 31 May 1976.

Dr. Waldo Perfecto, Executive Director, EDPITAF, Department of Education and Culture, Metro Manila, 21 July 1977.

Dr. Agustin Pulido, President, Central Philippine University, Iloilo City, 25 April 1977.

Dr. Sebastian S. Quiniones, Dean, College of Agriculture, Central Luzon State University, Muñoz, Nueva Ecija, 14 July 1977.

Mr. Antonio Rocha, Jr., Director of Research, Isabela State College of Agriculture, Echague, Isabela, 8 May 1977.

Mrs. Amalia V. Rodriguez, Regional Officer, NSDB, Cebu City, 29 April 1977.

Dr. Juan Salcedo, Jr., President, Science Foundation of the Philippines, Metro Manila, 8 March 1977.

Dr. Ramon L. Samaniego, Coordinator for Research, Sugar Technology Program, U.P. at Los Baños, Laguna, 19 July 1977.

Dr. Abelardo G. Samonte, Chancellor, University of the Philippines at Los Baños, Laguna, 14 February 1977.

Rev. Fr. Robert Schmitz, SVD, Vice President for Finance, University of San Carlos, Cebu City, 27 April 1977.

Rev. Fr. Enrique Schoenig, SVD, Chairman, Department of Biological Sciences, University of San Carlos, Cebu City, 27 April 1977.

Dr. Ernesto P. Sonido, Chairman, Department of Geology and Geography, University of the Philippines, Quezon City, 22 July 1977.

Dr. Reynaldo A. Tabbada, Chairman, Department of Botany, University of the Philippines, Quezon City, 22 July 1977.

Mr. Hipolito Talavera, Acting Chief of Administrative Services,NSDB, Metro Manila, 31 May 1976 and 24 November 1976.

Mr. Jorge Tamayo, Vice President for Administration and past Dean, College of Engineering, Central Philippine University, Iloilo City, 26 April 1977.

Miss Lydia Tansinsin, President, Philippine Institute of Chemical Engineers and Chief of the Planning and Programming Division, NSDB, Metro Manila, 17 May 1977.

Dr. Augusto Tenmatay, Project Educator, EDPITAF, Department of Education and Culture, Metro Manila, 21 May 1977.

Rev. Fr. Quintin Terrenal, SVD, Vice President for Academic Affairs, University of San Carlos, Cebu City, 28 April 1977.

Dr. Ruben Umaly, Director of Academic Program and Coordinator, General Education and Extramural Studies Program, University of the Philippines, Quezon City, 9 August 1977.

Dr. Victor Valenzuela, Executive Director, Association of Philippine Medical Colleges, Manila, 31 August 1977.

Mr. Jaime R. Velasco, Technical Staff, Education and Training Division, NSDB, Metro Manila, 31 May 1976; 25 February 1977.

Dr. Jose R. Velasco, Commissioner, National Institute of Science and Technology, Manila, 10 March 1977.

Mr. Isaac M. Vera Cruz, Chairman, Department of Engineering Sciences, College of Engineering, Central Luzon State University, Muñoz, Nueva Ecija, 14 July 1977.

Mr. Robert C. Villanueva, Chairman, Department of Physical Sciences, Central Luzon State University, Muñoz, Nueva Ecija, 5 July 1977.

Mr. Gaudencio A. Villaroman, Dean, College of Engineering, CLSU, Muñoz, Nueva Ecija, 26 May 1977.

Mr. Pedro Yap, Dean, College of Engineering and Architecture, University of San Carlos, Cebu City, 28 April 1977.