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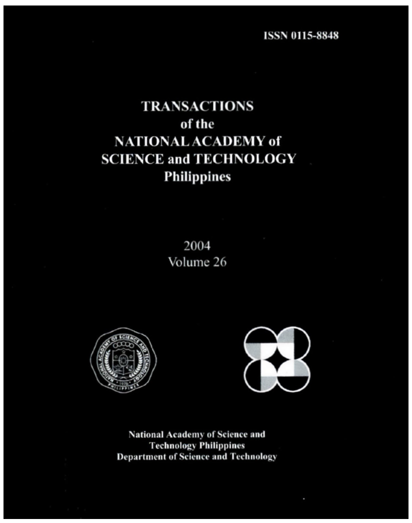

SCIENCE CULTURE AND EDUCATION FOR CHANGE
Part II: Breaking Barriers Impeding Widespread Development of Scientist Manpower in the Philippines

Christopher C. Bernido and
M. Victoria Carpio-Bernido

Research Center for Theoretical Physics
Central Visayan Institute Foundation
Jagna, Bohol 6308, Philippines

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Part II. Breaking Barriers Impeding Widespread Development of Scientific Manpower in the Philippines

Christopher C. Bernido and M. Victoria Carpio-Bernido
Research Center for Theoretical Physics
Central Visayan Institute Foundation
Jagna, Bohol 6308, Philippines

Abstract

Barriers hindering the widespread development of scientific manpower in the Philippines are examined. Specific measures aimed at breaking these barriers are proposed. These involve concerted effort of the government and private sectors. A small privately run research center in the island province of Bohol, which has gotten support from the Department of Science and Technology and foreign agencies on a project-by-project basis, is cited as an initiative with modest but real contributions.

Key words: science culture, scientific manpower, science education

In our society, there exist barriers preventing us from creating a pool of Science and Technology professionals that can make the country globally competitive. Because of these barriers, Philippine science has been drawing its strength only from a limited sector of the society. The factors which impede the development of our scientific manpower are identified in this paper as the following: (1) a language problem (English) which discourages many scientifically inclined children at the grassroots level, (2) the lack of geographically accessible educational centers of excellence, (3) the lack of qualified Ph.D. research advisors, and (4) the brain drain phenomenon. The situation is illustrated in Figure 1 next page where each barrier acts like a sieve that filters out students with talents for science.

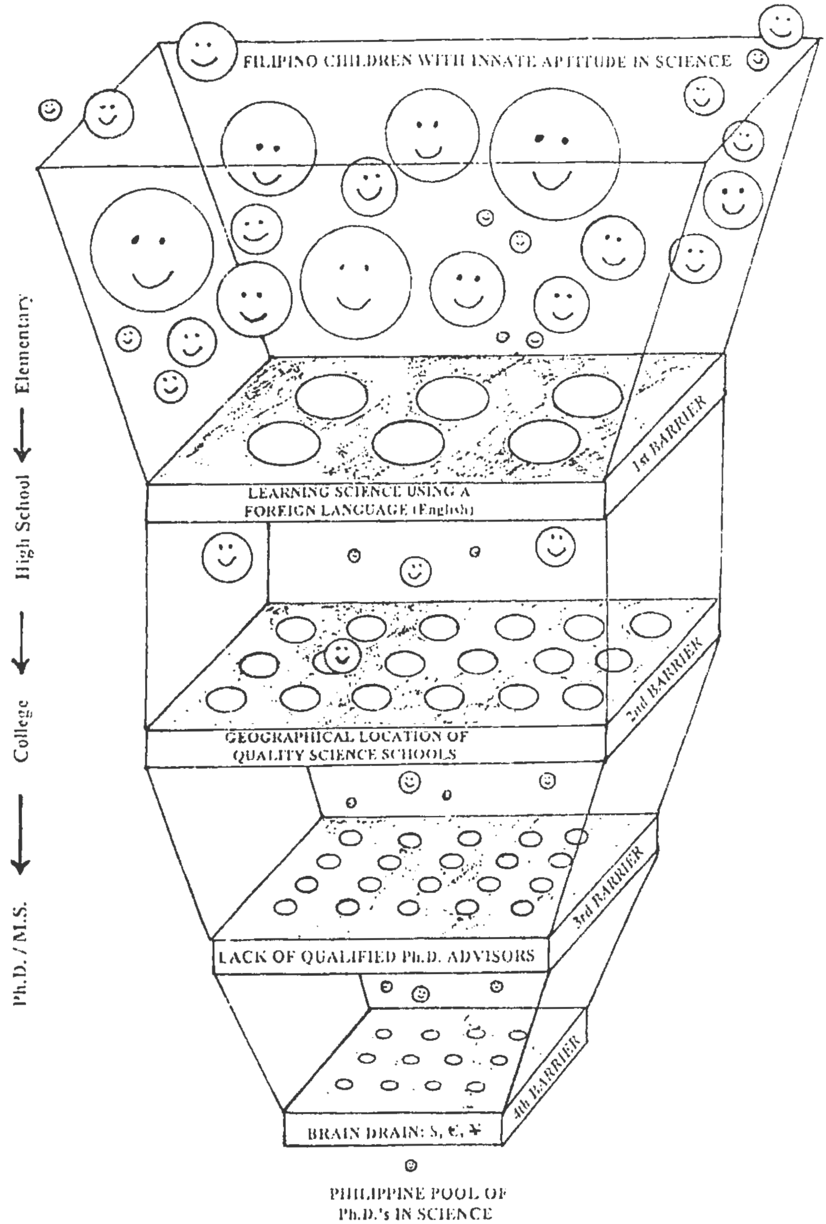

Figure 1. Factors that impede scientific manpower development in the philippines.

Solving the four-barrier problem can, indeed, be mind-boggling. Granting that we are able to solve barriers (1) to (3), barrier number (4) remains to be a threat that undermines all efforts to develop and maintain a decent scientific manpower. The most devastating factor is the exodus of talents to other countries, or brain drain. The dreaded brain drain also exacerbates the other barriers since it naturally leads to a lack of qualified Ph.D. research advisors, and depletes the qualified personnel needed to man geographically strategic educational centers of excellence.

Breaking the Barriers

The first problem – the language barrier belongs to Basic Education, and can be handled by the Dynamic Learning strategies advocated in Part I of this paper [*1*]. The three remaining barriers are interconnected. This implies that a solution for one also partially solves the others. Consider, for instance, the dreaded brain drain phenomenon because it is capable of generating the other barriers. Brain drain is like a continuous leak in the bucket that we are furiously trying to fill with water. There are, however, two ways to approach this problem. One involves patching up the hole, but the hole can recur if the pressures involved are too high. The second way is by redirecting water that has leaked out back into the bucket. The brain-drain problem is complex in view of its economic, political, and global features. Given our poor economic scenario, is there a way of partially neutralizing the effects of brain drain that at the same time partly breaks the other identified barriers? We think there is, and the solution that partially breaks all barriers has, in fact, concretely been tried and tested (see section 3), but so far, only on a very small scale and mainly through private initiative. The solution is not that expensive, and it actually promotes a *reverse* brain drain, or *brain gain* (redirecting water back into the bucket), where noted scientists, of foreign or Filipino origin, can do first-rate research in our country. A cost-effective solution that has been proven to be a workable model (see, e.g., sections 3 and 4) is contained in the following recommendation:

The establishment of a government-supported institute(s) dedicated to fundamental research and characterized by the following:

1. A scientific staff of 3 to 5 Ph.D.s of proven research capability, augmented by Visiting Scientists whose appointments can range from 3 weeks to 3 months;
2. The institute accepts Ph.D. students for thesis advising;
3. The institute should be geographically located so as to serve the dual purpose of: (a) being accessible to untapped young talents at the grassroots level, and (b) being attractive enough for foreign scientists;
4. The institute should endeavor to obtain private and foreign funding to allow a wider range of scientific activities.

From the economic point of view, a team which can do theoretical research work can be formed immediately. A theory group also has a significantly high ratio of scientific gain to cost of funding. Depending on the budget, a team for experimental work can then follow. The emphasis on theoretical work is motivated by the fact that one can do internationally competitive research with essentially just paper and pen, plus a few books. It has been observed that similarly minded paper and pen first-rate scientists from advanced countries do not really mind visiting a place with minimal infrastructure. If the site is a major tourist destination it, of course, becomes an added advantage. With local Ph.D. students rubbing shoulders with internationally noted scientists, first-rate science can slowly take root in our country, and a brain gain takes place.

At present, there are several educational institutions for the basic sciences within the University of the Philippines (UP) system, such as the National Institute of Physics and the Marine Science Institute in Diliman. High caliber science has been slowly emanating from these institutes, but not fast enough and plenty enough, considering that we are a country of 70 million people. For UP as a whole, its lack of research output is partly reflected by the fact that our premier university only ranks number 48 in the Asia's Best Universities 2000 ranking [2]. These science institutes of UP do suffer from a lack of qualified and willing Ph.D. thesis advisors, and most of the productive researchers are saddled with teaching and administrative duties which come with a university set-up.

A research institute's independence from traditional state-supported or private universities in the country allows for greater freedom and minimal bureaucracy. From its neutral position, it could contribute more effectively in upgrading standards of advanced science instruction in various educational institutions in the area through linkages, workshops, and research training sandwich programs. Moreover, local Ph.D.s from various universities can come and interact under the Visiting Scientist program of the institute. Creativity, independence of thinking, as well as the cross-fertilization of ideas required in scientific inquiry are enhanced in this setting.

Once established, a regular monitoring of the research institute is advisable. The institute's progress can be measured based on: (1) its number of publications in international journals; (2) its international linkages and ability to attract first-rate scientists from the international scientific community, and (3) its ability to obtain grants from local and foreign sources.

Although having strategically located research institutes devoted to fundamental research is a tried-and-tested pattern in advanced countries (see section 4 on the Max Planck Institutes of Germany), one can also cite the Tata Institute of Fundamental Research (TIFR), a success story in Mumbai, India. This world-renowned institute established in 1945 has served as a magnet for world-class Indian and foreign scientists to work and do research in Mumbai. The TIFR serves as a model where brain drain can partially be reversed. The Institute has several field stations and research facilities in different parts of the country. At present, the TIFR has 400 scientists grouped into three major schools namely, the School of Mathematics (which has a center at Bangalore), the School of Natural Sciences, and the School of Technology and Computer Science. Recently, the National Centre for Biological Sciences in Bangalore, India, was created as part of TIFR with the mandate to carry out basic research in the frontier areas of biology.

The Research Center for Theoretical Physics in Jagna, Bohol

In view of the fact that each country possesses a unique social, economic, and political environment, a workable model in other countries does not necessarily imply that the model would also work in the Philippines. It is therefore instructive to cite a test case, within the Philippine context, of a research center and its efforts to promote brain gain. The small privately run Research Center for Theoretical Physics (RCTP) in Jagna, Bohol, for example, has managed to attract first-rate scientists which include G. 't Hooft (*1999 Nobel Prize in Physics*), H. Araki (*2003 Henri Poincare Prize*), F. Wilczek (*Editor-in-Chief, Annals of Physics*), J. Klauder (*former Editor-in-Chief, Journal of Mathematical Physics*), C. DeWitt-Morette (*Founder, Les Houches Summer Schools*), T. Hida (*inventor of the Hida calculus*), H. Ezawa (*former President, Japan Physical Society*), and many authors of successful advanced physics books such as, L. Schulman, F. Wiegel, L. Streit, and G. Roepstorff, among others. During the visits of these scientists, which ranged from four days to three weeks, the RCTP made it a point to invite young Filipino students to benefit from their stay. The students came from the University of the Philippines, De La Salle University, and the MSU-Iligan Institute of Technology.

Since its creation in 1992, the RCTP has served as a tropical venue for small meetings, discussions or simple private retreats to gain new perspectives and ideas. With its informal and relaxed atmosphere, it has served as a place where interfaces between various areas of physics could be explored. The RCTP staff has also been advising M.S. and Ph.D. students from the National Institute of Physics, University of the Philippines, for their thesis work. Presently, the RCTP has a 5-year Memorandum of Agreement with the MSU-Iligan Institute of Technology designed to assist its newly instituted Ph.D. (Physics) program. Several of the MSU-IIT physics graduate students have been visiting the RCTP, especially when foreign scientists are around. Moreover to alleviate the lack of qualified Ph.D.s in nearby educational centers, the RCTP allows its staff to have a Visiting Lecturer arrangement with physics departments of neighboring universities for selected advanced topics. This is the case with MSU-IIT, and possibly by June 2004, with the physics department of the University of San Carlos, Cebu City. In line with its objectives, the RCTP has organized three international workshops with local and foreign funding as follows:

- 1st Jagna International Workshop on Advances in Theoretical Physics, **4 – 7 January 1995.** *Major Sponsors*: **Department of Science and Technology, International Centre for Theoretical Physics (Italy), Alexander von Humboldt-Stiftung (Germany), UNESCO-ROSTSEA (Jakarta), National Research Council of the Philippines, *Samahang Pisika ng Pilipinas*, Philippine Convention and Visitors Corporation.**

- 2nd Jagna International Workshop: Mathematical Methods of Quantum Physics, **4 – 8 January 1998.** *Major Sponsors*: **Department of Science and Technology, Abdus Salam International Centre for Theoretical Physics (Italy), Alexander von Humboldt-Stiftung (Germany), Philippine Charity Sweepstakes Office, De La Salle University, Philippine Convention and Visitors Corporation.**

- 3rd Jagna International Workshop: Functional Integrals in Stochastic and Quantum Dynamics, **4 – 17 January 2001.** *Major Sponsors*: **Department of Science and Technology, Alexander von Humboldt-Stiftung (with support from the Federal Ministry for Education, Science, Research & Technology of Germany), Abdus Salam International Centre for Theoretical Physics (Italy).**

Aside from the international support it received during these Workshops, the RCTP also obtained a three-year (1999-2002) DM 60,000 research project grant from Germany's Federal Ministry for Education, Science, Research & Technology administered by the Alexander von Humboldt-Stiftung.

Although the RCTP is in a non-urban area, the island province of Bohol is strategically located and is the present number one tourist destination in the Philippines. It has an airport and several seaports linking it to the international gateway cities of Cebu and Manila. The town of Jagna, from where Camiguin island can be seen, has a port which connects it to several neighboring provinces in the Visayas and Mindanao by sea. Guests could thus easily go to many places of interest in the Philippines and the rest of the Asia-Pacific area.

Being privately run and lacking a regular budget the RCTP, nonetheless, has managed to induce a brain gain. With its strategic location, it has also been able to assist the physics department of the MSU-Iligan Institute of Technology. The MSU-IIT has been identified as an educational Center-of-Excellence in physics by virtue of CHED Resolution no. 021-98 – the only one outside of Luzon. The RCTP has also conducted workshops for high school and tertiary science and math teachers. One of these, for example, was the five-week (April 17 – May 19, 1995) "Seminar in Nuclear Science for High School Teachers," organized in cooperation with the Philippine Nuclear Research Institute. Such modest gains, however, could still be enhanced with the availability of more regular government support.

The Max Planck Research Institutes

How should research institutes for basic research in the Philippines look like several decades from now? An interesting model would be the Max Planck Research Institutes of Germany, since Germany has a population comparable to that of the Philippines. Adjustments, however, have to be made since Germany is one of the wealthiest countries in the world. The Max Planck Society for the Advancement of Science is an independent, non-profit research organization. It runs research institutes for basic research and takes up new and innovative research areas that German universities are not in a position to accommodate or deal with adequately [3]. The interdisciplinary research areas they tackle often do not fit into the university organization. Max Planck Institutes, however, complement the work done at German universities. Some of the Max Planck Institutes perform service functions for research performed at universities by providing equipment and facilities, such as telescopes, large-scale equipment, and specialized libraries.

The Max Planck Society is not a government institution although it is funded to a large extent by the federal and state governments of Germany. Founded on February 26, 1948, the Society had initially 25 research institutes. By June 1960, the Max Planck Society had 40 institutes and research facilities. This grew to 52 institutes in 1966. Today, there are about 80 autonomous research institutes of the Max Planck Society primarily devoted to fundamental research.

The sizes of the research institutes can vary. For instance, the Max Planck Institute for Gravitational Physics, founded in 1995, had an initial staff of about 10 scientists. Today it has approximately 30 full-time scientists, supplemented by 150 Visiting Scientists each year. At this institute, a number of diploma and Ph.D. students are also supervised. The Max Planck Institute for Biochemistry, on the other hand, had 792 employees in 1998 (including people funded by 3^{rd} parties) of which 475 were scientists (including junior and guest scientists) and 207 technical staff.

The Max Planck Research Institutes are geographically spread out all over Germany. We list below *some* of the Max Planck Institutes and their location.

1. Max Planck Institute for Physics (*Muenchen*)
2. Max Planck Institute for Extraterrestrial Physics (*Muenchen*)
3. Max Planck Institute for Astrophysics (*Garching*)
4. Max Planck Institute for Quantum Optics (*Garching*)
5. Max Planck Institute for Plasma Physics (*Garching*)
6. Max Planck Institute for Biochemistry (*Martinsried*)
7. Max Planck Institute for Neurobiology (*Martinsried*)
8. Max Planck Institute for Biological Cybernetics (*Tuebingen*)
9. Max Planck Institute for Solid State Research (*Stuttgart*)
10. Max Planck Institute for Nuclear Physics (*Heidelberg*)

11. Max Planck Institute for Astronomy (*Heidelberg*)
12. Max Planck Institute for Medical Research (*Heidelberg*)
13. Max Planck Institute for Informatics (*Saarbruecken*)
14. Max Planck Institute for Computer Science (*Saarbruecken*)
15. Max Planck Institute for Chemistry (*Mainz*)\
16. Max Planck Institute for Polymer Research (*Mainz*)
17. Max Planck Institute for Biophysics (*Frankfurt am Main*)
18. Max Planck Institute for Brain Research (*Frankfurt am Main*)
19. Max Planck Institute for Radioastronomy (*Bonn*)
20. Max Planck Institute for Mathematics (*Bonn*)
21. Max Planck Institute for Terrestrial Microbiology (*Marburg*)
22. Max Planck Institute for Biophysical Chemistry (*Goettingen*)
23. Max Planck Institute for Microstructure Physics (*Halle*)
24. Max Planck Institute for Mathematics in the Sciences (*Leipzig*)
25. Max Planck Institute of Molecular Cell Biology and Genetics (*Dresden*)
26. Max Planck Institute for Molecular Genetics (*Berlin*)
27. Max Planck Institute for Gravitational Physics (*Golm*)
28. Max Planck Institute of Molecular Plant Physiology (*Golm*)
29. Max Planck Institute for Dynamics of Complex Technical Systems (*Magdeburg*)
30. Max Planck Institute for Meteorology (*Hamburg*)

Need for a Concerted Effort

Ideally, to be globally competitive in science, the Philippines could aim to have the same number of research institutes as the Max Planck Society of Germany. The Philippine society, however, faces barriers that hinder the growth of an internationally competitive scientific community. Brain drain has been the most telling of all these barriers, and the situation can become worse. There is a growing trend in advanced countries where lesser and lesser university students take up science and technology as a career. This trend, coupled with the tendency of advanced countries to decrease in population, means that they would become more aggressive in recruiting up-and-coming Ph.D.'s in science from Third World countries. This, in fact, has already started in Germany where attractive long-term research positions are offered to young talented Ph.D.s in science from all over the world. Germany has the resources and the research institutes to absorb these young scientists.

The Philippines has to take real and immediate steps if it does not want to continually lag behind in the race for new scientific knowledge and its high technology applications. One concrete action to partially reverse brain drain is to establish government-supported internationally competitive institutes devoted to fundamental research, separate from traditional university structures. Experience from the private sector, such as the RCTP, has proven that a research institute for fundamental research can promote brain gain. Research in theoretical science does not cost much, and the scientific gain to cost ratio is high. When additional budget becomes available, experimental research sections can then be added to the research institutes.

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