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I

IN last year's annual State of the Nation address, President Ramon Magsaysay asked for the promotion of scientific research as a basis of economic and social development. As a necessary adjunct to such a program he urged the adoption of education reforms geared to the requirements of scientific progress.[1]

Of all the steps necessary for the implementation of such a program, the most fundamental of all is the establishment of a solid undergraduate training of the future scientist. In view of this, a partial study has been made of the present status of such a training in the Philippines. The study is limited to the training of the professional chemist because, although the President spoke of scientific research in general, it would seem that among the sciences chemistry has one of the greatest potentials for assisting economic and social development in the Philippines. This claim is based both on the experience of other countries[2] and on the present state of Philippine resources and economy.

[1] *Official Gazette* 52 (Jan. 1956) 98.

[2] Puerto Rico, for instance, is today strengthening her economic life by a growing chemical industry. She has now two new oil refineries, a $12.3 million ammonia plant and chemical firms producing fertilizers, insecticides, paints, plastic and refinery products. Cf. E.T. Ellenis, "Puerto Rico—Carribean Chemical Center," *Chemical and Engineering News* 34 (28 *May* 1956) 2630-2633.

It is vital to this report to distinguish carefully between the professional chemist, the chemical engineer and the laboratory technician. The latter is usually employed in following carefully worked out procedures which require no fundamental knowledge of the theory involved. Confronted with a new problem or with unexpected difficulties in routine work, he usually must ask for assistance. The chemical engineer strives to translate chemical processes from the small laboratory scale to the industrial scale. He deals in pounds, tons and carloads rather than in grams and spoonfuls, and is interested in such items as the size of reactor needed to produce two tons of aspirin per day or the amount of water required for temperature control in the production of one ton of nitroglycerine. Granting the importance of both the engineer and the technician, both in a well developed chemical industry and in one that is just starting to grow, it is none the less true that the professional chemist is more fundamental to the entire edifice of chemical progress.

A proper undergraduate training should prepare the professional chemist either to go directly into industrial work or to pursue graduate studies where he will learn the more advanced theories and techniques required for research. As the President pointed out, an adequate research program is of the greatest importance for future Philippine economy, an economy based on the use of our own native raw materials. Furthermore, in addition to these research-for-development opportunities, there are also problems and difficulties which are, so to speak, of local vintage. The *kadang-kadang* coconut blight is a good example.[3] It is difficult to interest foreign scientists in problems of such local concern. We need a good number of professional chemists in the Philippines who are trained to carry on research work on such local problems.

This survey, therefore, will consider the college course requirements for the B. S. degree in Chemistry, since this degree embodies the standard undergraduate training of the

[3] Studies in the chemical nature of this disease are limited to but a single report, as is evident from a complete search of *Chemical Abstracts* and of *Biology Abstracts* up to the end of 1954 inclusive.

professional chemist. A comparison will be made of the Philippine curricula with those offered by comparable institutions in the United States.[4] It is generally recognized today that in the United States the professional chemist does receive an adequate undergraduate training. In this study, the identities of the various Philippine schools have been deliberately concealed because our aim is to present a national picture rather than a comparative survey of curricular differences between the various Philippine schools. It is hoped that by knowing our present strength and weaknesses we may build more wisely for the future.

The data used in the present study were obtained from the official catalogs of institutions offering a bachelor of science degree with a major in chemistry during the school-years 1954-1956. Inquiries were sent to forty-three institutions offering collegiate courses with the request for a catalog should they offer a bachelor's degree in chemistry. Thirteen replies were received, although only nine of these offered the desired degree. It was fortunate, however, that returns were had from all institutions whose undergraduate chemistry curricula are commonly recognized as being among the best to be found in the Philippines today. No school of recognized standing in the sciences failed to answer the questionnaire.

II

Before examining the data it will be necessary to establish certain definitions. A "Fundamental Course" is a recognized basic course at the bachelor's level. The undergraduate curriculum usually includes the following fundamental courses: Inorganic, Analytical (Qualitative and Quantitative), Organic and Physical Chemistry. An "Applied Course" is one whose more immediate objective is the practical application of chemical knowledge to specific industrial or agricultural uses. It is a course generally offering no new insight into theoretical questions. It includes such subjects as: Technical Analysis,

[4] It is granted that comparisons of this sort can be misleading, especially where cultural, economic and educational conditions vary. Nevertheless, the proven worth of the undergraduate training of professional chemists in the United States makes such a comparison quite useful.

Food Analysis, Soaps and Detergents, Fats and Oils, Sugar Chemistry, Fermentation, Industrial Chemistry, Industrial Organic, Industrial Biochemistry, Chemical Economics and Chemical Processes. An "Advanced Course" is one that penetrates more deeply into the theories and practice of some segment of any of the Fundamental Courses. It is usually given at the graduate or senior undergraduate level and is listed as "advanced" in the catalogs. Such, for instance, would be Advanced Organic, Thermodynamics, Biochemistry, Colloid Chemistry. A "Special Course" is one belonging to an arbitrary category established for the purpose of this report. Only the following subjects are included: Chemical Literature, Chemical Communications, Instrumental Analysis, Applied Statistics, Thesis Seminar and Research Problem. These subjects are among the latest additions to the bachelor's curriculum in the United States brought about by the growing complexity and demands on the background training of today's chemist.[5] Chemical Literature aims at giving the student a facility in handling as tools of research the chemical journals and other references found in a science library. Communications includes courses in English composition and Oral English that prepare the student to express his thoughts, especially in his professional field, orally or in writing, in a clear, logical and accurate manner. It is this subject that prepares him to write technical reports and deliver technical talks that are both scholarly in their content and polished in their literary form. Instrumental Analysis is not to be confused with Instrumentation. Instrumental Analysis does not delve into the operational details of a particular instrument. Rather it is geared at giving the student the fundamental concepts governing chemical analyses through the use of instruments.[6] A course in Applied Statistics aims at

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[5] On the desirability of such Special Courses in today's chemistry curriculum, see for instance: W. F. Hart, "Evaluation of an Undergraduate Chemistry Curriculum," *Journal of Chemical Education* 31 (July 1954) 361-364; and Martin Kilpatrick, "Building a Chemistry Department," *ibid.* 31 (May 1954) 247-250.

[6] For the role of Instrumental Analysis in the undergraduate program see for instance: H. A. Laitinen, "Introductory Remarks: to a symposium on problems in the teaching of Instrumental Analysis," *Journal of Chemical Education* 33 (Sept. 1956) 422-441; and H. A. Strobel, "The Objectives of a College Course in Instrumental Analysis," *ibid.* 31 (March 1954) 159-162.

familiarizing the future chemist with the applications of statistical analysis in chemical investigations. It should prepare him to handle this mathematical tool with efficiency, both in the design of his experiments and in the interpretation and evaluation of his experimental data. Thesis and Research Problem offer the student an opportunity to manifest any abilities expected of candidates for graduate work, and the professor a means of evaluating that potential.[7]

III

With the aid of these definitions we will examine the undergraduate training that Philippine schools offer for the future professional chemist. The significant questions we seek answers to are: What is the caliber of today's undergraduate chemistry curriculum in the Philippines? Does it provide the professional chemist with a sufficiently solid training to cope with present needs and future developments? Granting that such a question cannot be completely answered by consulting college catalogs, nevertheless a partial answer certainly can be obtained because course requirements are the backbone of undergraduate training.

The core of all undergraduate curricula are the Fundamental Courses listed in Table I. Most graduate schools of chemistry require for admission a minimum of eight credits in undergraduate Inorganic, Analytical, Organic and Physical Chemistry, including laboratory work in all four. The position of Qualitative Analysis in the United States is open to much discussion today,[8] though the trend is away from a separate course. Table I clearly shows that the Philippine schools are quite adequate in the hours devoted to these basic courses. Only in Quantitative Analysis are they somewhat below the U. S. level. Slight though this deficiency might seem, it is important that this be corrected. Of the four courses Quantitative Analysis is of the greatest universal value. For instance, an organic chemist consciously uses the principles and practices

[7] Cf. Fritz Fromm, "A Three-year Program for Undergraduate Seminar and Research," *Journal of Chemical Education* 33 (July 1956) 347-349.

[8] At the Fall 1956 meeting of the American Chemical Society an entire symposium was devoted to this topic.

TABLE I. Credit Load in Fundamental Courses[a]

SCHOOL			INORGANIC[b]		ANALYTICAL				ORGANIC		PHYSICAL	
					Qualitative		Quantitative					
			Lect.	Lab.	Lect.	Lab.	Lect.	Lab.	Lect.	Lab.	Lect.	Lab.
P												
H		A	6	4	3	2	3	2	6	4	6	2
I	S	B	6	4	0	0	3	2	5	3	6	4
L	C	C	6	4	2	2	2	2	6	4	6	4
I	H	D	6	4	3	2	3	2	6	4	6	2
P	O	E[c]	—	—	—	—	—	—	—	—	—	—
P	O	F	6	4	2	2	2	2	6	4	6	2
I	L	G	6	4	3	2	3	2	6	4	6	4
N	S	H	6	4	3	2	3	2	6	4	6	4
E		I	6	4	3	2	3	2	6	4	6[d]	4[d]
U.S.A.[e]			6	2-4	3	2	4	4	6	2-4	6	2

[a] Only a four-year curriculum is included in this table.
[b] Inorganic Chemistry includes a General Chemistry course. It may include some Qualitative Analysis.
[c] Information received from this institution was not sufficiently detailed to indicate the individual chemistry courses.
[d] This is an elective course.
[e] On the basis of catalogs of typical American institutions offering a four-year course in undergraduate chemistry. The institutions are all accredited by the American Chemical Society.

TABLE II. Credit Load in Advanced, Special and Applied Courses.

SCHOOL			ADVANCED		SPECIAL		APPLIED	
			Lect.	Lab.	Lect.	Lab.	Lect.	Lab.
P								
H		A	13	4	4	5	18	6
I	S	B	0	0	2	0	7	2
L	C	C	14	8	3	8	25	4
I	H	D	9	3	8	0	30	8
P	O	E[a]	—	—	—	—	—	—
P	O	F	5[b]	3	9[b]	6	6[b]	4
I	L	G	10	6	3	5	13(17)[c]	6(10)[c]
N	S	H	6	2	2	6	10	4 or 6
E		I[d]	(10)	(10)	(2)	(3)	(6)	(0)
U.S.A.			4-12	0-4	2-4	2-5	0	0

[a] Information received from this institution was not sufficiently detailed to indicate the individual chemistry courses.
[b] The minimum requirements are indicated. In addition the student is required to take six lecture elective credits in chemistry. These may be chosen from courses in any of the three fields of Advanced, Special or Applied.
[c] Four lecture and four laboratory elective credits may be either in Applied or other Natural Science courses.
[d] In this institution the student has twenty elective credits in chemistry to fulfill. The numbers in parentheses are the total credits in a given field that he can choose from.

of Inorganic and Physical Chemistry to a lesser extent than those learned in the Quantitative course. There are few research projects in any of the many fields of chemistry that are accomplished without the application of Quantitative Analysis. The need for a full eight credits' load is felt even more in this day of increasing use of instrumental methods of analysis.

In considering the data in Table II, it should be remembered that it is in the field of these Advanced, Special and Applied Courses that the particular aims of the individual institutions will be more clearly expressed. The three classifications will be considered separately. First, with regard to Advanced Courses, it will be noticed that Philippine schools generally devote more time to these than is common in the United States. Taken by itself, this is certainly praiseworthy since it reflects a concern for training beyond the minimum requirements. It is less desirable, however, if it is part of a general picture of overmultiplication of courses or of overspecialization, as will be discussed later.

In the field of Special Courses, it is encouraging to see that a good number of our Philippine schools are aware of these latest trends in chemical education.

It is in the field of Applied Courses that a very significant difference is noted. The bachelor's degree in the United States rarely requires any of these courses. This should not be interpreted as meaning that the students are not prepared for a career in industry, for the majority of them in the U. S. go directly into industry. The reason for this sacrifice of highly specialized, descriptive and "know-how" courses is the desire to emphasize basic principles, ideas and theories, as well as skills in solving diverse chemical problems. This is the more far-sighted approach. It equips the future chemist, not with ready solutions to specific problems, but with such a familiarity with fundamental principles that he will know how and where to look for the answers to the now unknown problems he will have to meet in the future. It is felt that the Applied Courses are more appropriate to the trade school or technical institute than to a professional education. Industry, too, seems to prefer to give its own in-service[9] training to the thoroughly grounded student, than to accept a ready-made complete package. The presidential address of J. C. Warner at the Fall meeting of the American Chemical Society last year makes this point very clear, as well as the need to continue and improve this emphasis on basic training.[10] The considerable load of Applied Courses in the Philippine curricula can be ascribed to no one cause. Since, as President Magsaysay has pointed out, the Philippines of today and yesterday is so very weak in chemical industries and in the industries and in the chemical research required to exploit our natural resources,[11] it was perhaps thought that such curricula would best stimulate scientific endeavor. Stemming also from the meagerness of Philippine research is the fact that the B. S. degree here is more of a terminal award than it is in the United States. It would be easy to use this as a reason for wishing to cover as much of practical fields as possible during the formative years. In view, however, of our need precisely of professional chemists who will be trained to carry out research in the Philippines, it might be wiser to free the student of those know-how courses so that he could devote more time to the fundamental courses. The college graduate who goes immediately into industry will also benefit from such a change, as Dr. Warner observes.

Table III reveals that in chemistry, mathematics and the other natural sciences the credit load in the Philippines is decidedly greater than that found in the United States. Perhaps because of this the non-science loads are, as a rule, comparatively low. The stress on chemistry subjects may appear quite legitimate in a curriculum designed to train professional chemists. But it should not be forgotten that, in the adequate formation of the chemist qua chemist should be included as an integral part, his development as a professional man. It is this

[9] We have in mind primarily the informal training that all "new men" receive when they are put under the care of an experienced worker. However, formal in-service training is becoming more popular especially in large chemical plants.

[10] J. C. Warner, "Is Chemical Education too Specialized?" *Chemical and Engineering News* 34 (1 Oct. 1956) 4786-4789.

[11] Tribute must be paid to the not so numerous institutions and individuals both here and abroad who have in the past swam steadily against that lethargy.

TABLE III. Course Load for Bachelor's Degree in Chemistry.[a]

SCHOOL		CHEM-ISTRY Lect. & Lab.	OTHER NATURAL SCIENCES Lect. & Lab.	MATH.	TOTAL SCIENCE	TOTAL NON-SCIENCE	PER-CENT SCIENCE[b]
PHILIPPINE SCHOOLS	A	88	30	28	146	24	86
	B	44	40	21	105	37	74
	C	100	26	18	144	51	74
	D	96	16	21	133	51	72
	E	81	13	17	111	45	71
	F	75	10	22	107	45	70
	G	83(91)[c]	15(23)[c]	16	122	58	68
	H	70 or 72[d]	16[d]	25	111[d]	56[d]	66[d]
	I	60	10	22	92	102	47
U.S.A.		44-61	8-22	12-18	64-101	29-70	39-74

[a] Includes only four-year curricula in chemistry. Excludes all credits for Physical Education and R.O.T.C.
[b] On the basis of the sum of credits in the two immediately preceding columns.
[c] Eight elective credits may be either in chemistry or other Natural Sciences.
[d] This figure is exclusive of 3 credits for science or cultural elective.

TABLE IV. Faculty Academic Degrees.[a]

SCHOOL		BACCALAUREATE[b]	MASTER[b]	DOCTORATE[b]
PHILIPPINE SCHOOLS	A	13	1	0
	B	18	3	7
	C	18	4	5
	D	—	—	—
	E	—	—	—
	F	12	7	3
	G	—	—	—
	H	2	1	0
	I	2	0	0
U.S.A.[c]				

[a] Includes those teaching in the department of chemistry whether their degree be in Pure Chemistry, Chemical Engineering or Pharmacy.
[b] Roughly 50 percent of the degrees in the Philippine schools are not in Pure Chemistry, but in Chemical Engineering or Pharmacy. In one of the schools none of the professors hold a degree in Pure Chemistry.
[c] The vast majority of the professors have the Ph. D. Very seldom does one find a college professor with only a bachelor's degree.

professional aspect of a chemist's training that is not sufficiently satisfied by technical courses alone. It is the growing belief of experts in chemical education that today's undergraduate chemist should be exposed more and more to the subjects that *exploit intellectual potentialities, and less to specialized techniques.*

First of all, chemical education should have the characteristics of good professional education: an effective and adequate program of liberal studies as an integral part of the student's professional education; a curriculum which in its scientific content emphasizes basic principles, ideas, and theories, and the development of skill in their use in finding creative solutions to new problems; and the development of the desire and habit of learning from each experience, and of continuing to learn.[12]

It is therefore necessary that besides a solid foundation in chemical disciplines the undergraduate student should acquire a broader training than would result from an overspecialized curriculum. It is on the undergraduate level that the future chemist is to develop not only his laboratory techniques, but what is of more value, his powers of clear, accurate, imaginative thinking. Techniques can be acquired in a relatively short time. But the power of synthesis and analysis so essential to a professional man is the fruit of assiduous cultivation. Moreover, the content of chemical data is expanding at such a fast rate as to make it virtually impossible for a student to know even something about everything. The noted chemist and educator of the California Institute of Technology, Dr. Joel H. Hildebrand, admits:

...The major part of my working stock of chemistry was unknown at the time I received my doctor degree... A degree should represent not the store of knowledge completed, but a scientific career started in the right direction. We should be training athletes, not fattening hogs...[13]

To express this philosophy of the undergraduate curriculum in more concrete terms, we could say that the student is to acquire, in addition to a firm grasp on the core of chemistry subjects, a facility in using chemical literature intelligently, a

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[12] J. C. Warner, *op. cit.*, p. 4787.

[13] J. H. Hildebrand, "The Production of Scientists," *Chemical and Engineering News* 31 (7 Dec. 1953) 5088.

certain familiarity with modern laboratory instruments, an eagerness to keep up with advances in chemistry through the reading of journals, and, what is essential, the habit of thinking critically, yet with a mind always open to suggestions. The development of a disciplined imagination, of a healthy inquisitiveness and of a desire to go on learning after graduation—these are as much a part of his undergraduate training as is the acquisition of laboratory techniques. These processes require a long maturation period and the stimulation that comes from the example and the counseling of inspiring professors.

It would seem then that for the Philippines, part of the heavy load in chemistry courses could be lightened by de-emphasizing or omitting altogether the applied chemistry subjects, while stressing the quality and the quantity of the more fundamental courses, both scientific and humanistic, which develop the student's apperceptive powers. From Table III it is clear that in the U. S. there is a high percentage of liberal arts courses in the chemistry curricula. To be more specific, the following percentages of liberal arts subjects are found in the chemistry curricula of institutions noted for their emphasis on science: MIT, 23.8%; University of Wisconsin, 28.7%; Carnegie Institute of Technology, 22.6%; Case Institute of Technology, 22.6%; Lafayette College, Penn., 25.0%.[14] It is axiomatic that in the natural sciences it is basic principles, ideas and theories that are first laid hold of, rather than informational "know-how," in grappling with new problems and situations.[15]

With regard to mathematics, it is noted that the load is heavier than that in the United States, though perhaps not to a very significant degree. This may be due to an effort on the college level to help the high school graduate supply for any deficiences in mathematical background. That such a deficiency

[14] W. F. Hart, *op cit.*, pp. 363-364.

[15] J. C. Elgin, dean of engineering of Princeton University believes that in the future such a trend toward more cultural subjects in technical curricula will have grown to the extent that by 1975 in the United States they will be on an equal footing with scientific and engineering subjects: *Chemical and Engineering News* 33 (10 Oct. 1955) 4296-4297. See also the editorial "The Humanities and Engineering Curricula," by W. J. Murphy, *Chemical and Engineering News* 34 (28 May 1956) 2629.

does exist is shown by the survey tests conducted by the Bureau of Private Schools in 1953 and 1954. Those tests revealed that over 46,000 high school seniors in 1331 high schools were deficient in mathematics.[16] It would, of course, be more desirable if all that mathematics load in college be devoted to acquiring new matter rather than to partly reviewing high school mathematics. A chemist, especially if he intends to take up research in theoretical chemistry, will always welcome any further cultivation of mathematics.

From Table IV we are able to get some idea of the academic qualifications of the professors who teach the undergraduate curriculum. Three points can be made. First, the bulk of the professors possess only the baccalaureate degree. It certainly cannot be said, of course, that the man with the higher degree is necessarily the better educator. Nevertheless, it is well recognized today that a higher degree is a definite advantage, for such a man can teach the fundamentals with greater depth and precision because of his more advanced training. Secondly, what we have just said is all the more true when the B. S. degree is not in chemistry. The table shows a high percentage of engineering and pharmacy degrees,[17] and that among those whose formation has not gone beyond the college level. The preocuppations of those who have already received their specialized training on the undergraduate level naturally tends to express itself in the choice of course matter. An overemphasis on application and description can easily lead to a deemphasis of fundamental concepts. Finally, it is recognized today that research (the very discipline that the President is calling for) is helpful in developing the best qualities of the chemistry professor *as a teacher.* Teaching and research stimulate each other. Without the incentives of his own private research problem, a chemistry professor can easily become outdated and lose that enthusiasm which is responsible for inspiring students to go on to higher studies. An atmosphere of research in a school, even though the students partake of it only indirectly, is one

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[16] A. Isidro, "Need to Improve Educational System Stressed," 56th annual edition of *Manila Bulletin,* section VI (9 April 1956) 29.

[17] The objection is not to these degrees in themselves, but to having those with a minimal chemistry background teach future professional chemists.

of the great formative influences on the future professional chemist. Table IV points out a serious problem, for it is almost impossible for a man with only a B. S. to conduct original research, and even with an M. S. it is still difficult unless one has much experience under capable direction.[18] Granted that there are many good reasons why the majority of the professors in Philippine schools have not been required to have advanced study in the past, it would seem essential for their successful teaching and for the implementation of a proper research program[19] that this situation be remedied.

IV

By way of summary it is helpful to present here the main conclusions drawn from the present study. These provide answers to the questions formerly indicated: What is the caliber of today's undergraduate chemistry curriculum in the Philippines? Does it provide the professional chemist with a sufficiently solid training to cope with present needs and future developments? On the undergraduate level the distribution of credit loads in the matter of fundamental courses is rather adequate, with the exception indicated for Quantitative Analysis. There is, moreover, in chemistry departments in the Philippines today an effort to introduce in the bachelor's curriculum such modifications as are demanded by the rapid advances in chemistry and technology. There, is, however, a tendency to overemphasize applied courses. Such a propensity seems to militate against the better interests in the formation of a chemist. Stress on fundamental science principles rather than on science applications is today "not merely a trend, but a tidal wave" to use the expression of Dr. Raymond Kirk of the Brooklyn Polytechnic Institute in New York City.[20] Hand in hand with this

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[18] We are speaking in general terms. It is well known that there are outstanding exceptions right here in the Philippines; but the general statement is still true.

[19] Other obstacles to research, such as a heavy teaching load and insufficient salary, which force professors to spend what time they have left from class work in other jobs, are well known, but they are beyond the scope of this report. Cf. V.A. Tan, "Research in the U.P.," *The Manila Sunday Times Magazine*, 4 October 1953.

[20] Even United States book publishers have noticed recently a sharp increase in the demand for college texts that emphasize scientific fundamentals rather than applied science.

emphasis on fundamentals is that other need of stabilizing the position of cultural subjects in the chemistry curriculum so as to make them implement the growing demand in modern research for chemists endowed with a well-exercised creative imagination. To observe accurately, to think logically, to evaluate critically are today part and parcel of a chemist's education. It is such a background that offers him the power of discriminating the trivial from the important, and of correlating apparently unrelated areas of knowledge.

It is beyond the scope of this study to treat of the intangible factors in a chemistry training program simply because the college catalogs consulted do not treat of them. And yet factors such as these must not be lost sight of—how well are the courses implemented; how inspiring are the professors, both as competent teachers and as creative professionals; how adequate are the library and laboratory facilities; how much is really demanded of the student. It would, likewise, be interesting to know how many promising Filipino undergraduates are stimulated to go on to higher studies in chemistry, and how well has their baccalaureate training prepared them for graduate work, especially in foreign universities.[21]

Although the answers to these questions are not readily available still it is known that in 1955 only 37 Filipino students were studying chemistry in the United States. It is not known how many of these were doing only undergraduate work.[22] That information raises a question. A fairly good number of Philippine schools graduate men and women with the bachelor's degree in chemistry, in other words, professional chemists. Yet there is a recognized lack of active chemical research in the Islands.[23] The first step in correcting such a deficiency seems to be the proper implementation of our college chemistry curricula. The training of our future chemists must moreover be

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[21] It is the authors' personal experience that many Filipino students who come to United States schools for graduate work in chemistry find their undergraduate training to have been deficient.

[22] "Open Doors: a report on five surveys..." *Institute of International Education* (New York 1956).

[23] Cf. Rudolf Rahmann and Heinrich Schoening, "Research in the Philippines," *World Mission* 7 (Spring 1956) 80-93.

more and more impregnated with the spirit of research and scholarship. Such a spirit the student is to breathe from his own professors, themselves gripped and quickened by it. It is encouraging, indeed, to note a slow but growing trend toward such a spirit among our science students and faculty members. A hopeful sign is the growing number of Filipino students who seek professional advancement in graduate studies. And it is precisely one of the functions of a graduate department to enkindle to bright flames the spirit of scholarly research among its students. It is true that any program of educational improvement must keep in mind the needs, the capacities and the background of Filipino students, but adaptation should not dilute to the point of inefficacy the professional equipment considered essential in today's chemist.

THE LANGUAGE PROBLEM

The difficulties created by the use of a foreign language as the *primary medium of instruction in the schools*, as well as by the introduction of the National Language, which is also unfamiliar to all but the Tagalog-speaking pupils, have confronted educators with a most perplexing problem. The solution lies in a vigorous research program, the beginnings of which are now under way.

Report of the Mission to the Philippines
28 July 1949 UNESCO (Paris 1950) p. 18