7. As this article goes to press, there has arisen some confusion regarding the original taxonomic determination for the most-studied *Macrotermes* species in Kajiado. For the sake of correctness at the present time, W. Sands of the Centre of Overseas Pest Research in London recommends that this be called "*Macrotermes* sp? near *subhyalinus*."
8. ICIPE Annual Report (1973). Published in Nairobi and available on request to Librarian, ICIPE, P.O. Box 30772, Nairobi, Kenya, East Africa.
9. ICIPE Annual Report, *ibid.* (1974).
10. ICIPE Annual Report, *ibid.* (1975).
11. W. F. Wood, *Ann. Entomol. Soc. Am.* **67**, 988 (1974).
12. W. F. Wood, J. Shepherd, B. Chong, J. Meinwald, *Nature (London)* **253**, 625 (1975).
13. W. F. Wood and B. Chong, *J. Ga. Entomol. Soc.* **10**, 332 (1975).
14. G. D. Prestwich, *Ann. Entomol. Soc. Am.* **69**, 812 (1976).
15. A. Quennedey, *Recherche* **6** (No. 54), 274 (1975).
16. W. F. Wood, W. Truckenbrodt, J. Meinwald, *Ann. Entomol. Soc. Am.* **68**, 395 (1975).
17. G. D. Prestwich, B. A. Bierl, E. D. DeVilbiss, M. F. B. Chaudhury, *J. Chem. Ecol.* **3**, 581 (1977).
18. G. D. Prestwich, D. F. Wiemer, B. A. Solheim, J. Clardy, J. Meinwald, unpublished results.
19. G. D. Prestwich, *Proc. Symp. Int. Union Study Social Insects (Dijon)* (1975), p. 149.
20. _____, M. Kaib, W. F. Wood, J. Meinwald, *Tetrahedron Lett.* (1975), p. 4701.
21. G. D. Prestwich, S. P. Tanis, J. P. Springer, J. Clardy, *J. Am. Chem. Soc.* **98**, 6061 (1976); G. D. Prestwich, S. P. Tanis, F. Pilkiewicz, I. Miura, K. Nakanishi, *ibid.*, p. 6062.
22. G. D. Prestwich, *Insect Biochem.* **7**, 91 (1977).
23. _____, unpublished results.
24. T. Eisner, D. Aneshansley, L. Brattsten, G. Prestwich, unpublished results.
25. D. Elder, whose present address is International Laboratory of Marine Radioactivity, Oceanographic Museum, Principality of Monaco.
26. J. H. Butterworth and E. D. Morgan, *Chem. Commun.* (1968), p. 23; *J. Insect Physiol.* **17**, 969 (1971); _____, G. R. Percy, *J. Chem. Soc. Perkin Trans.* **1**, 2445 (1972); E. D. Morgan and M. D. Thornton, *Phytochemistry* **12**, 391 (1973).
27. J. S. Gill and C. T. Lewis, *Nature (London)* **232**, 402 (1971); C. N. E. Ruscoe, *ibid.*, **236**, 159 (1972).
28. P. R. Zanno, I. Miura, K. Nakanishi, D. L. Elder, *J. Am. Chem. Soc.* **97**, 1975 (1975).
29. E. Bernays, Centre for Overseas Pest Research, London, personal communication..
30. M. Jacobson, U.S. Department of Agriculture, Beltsville, Md., personal communication.
31. I. Kubo, Y.-W. Lee, M. Pettei, F. Pilkiewicz, K. Nakanishi, *J. Chem. Soc. Chem. Commun.* (1976), p. 1013.
32. I. Kubo, I. Miura, M. Pettei, Y.-W. Lee, F. Pilkiewicz, K. Nakanishi, *Tetrahedron Lett.* (1977), p. 4553.
33. These bioassays were run by Drs. G. B. Staal and D. J. Judy, Zoëcon Corporation, Menlo Park, Calif.
34. I. Kubo, Y.-W. Lee, V. Balogh-Nair, K. Nakanishi, A. Chapya, *J. Chem. Soc. Chem. Commun.* (1976), p. 949.
35. S. Hosozawa, N. Kato, K. Munakata, *Phytochemistry* **13**, 308 (1974); *Tetrahedron Lett.* (1974), p. 3753.
36. I. Kubo, S. P. Tanis, Y.-W. Lee, I. Miura, K. Nakanishi, A. Chapya, *Heterocycles* **5**, 485 (1976).
37. D. Arigoni, D. H. R. Barton, E. J. Corey, O. Jeger, L. Caglioti, S. Dev, P. G. Ferrini, E. R. Glazier, A. Melera, S. K. Pradham, K. Schaffner, S. Sternhell, J. E. Templeton, S. Tobinaga, *Experientia* **16**, 41 (1960); T. Kubota, T. Matsuura, T. Tokoroyama, T. Kamikawa, T. Matsumoto, *Tetrahedron Lett.* (1961), p. 325.
38. I. Kubo, unpublished results.
39. This tree was originally identified as *Xylocarpus molluscensis*. However, this identification now seems uncertain [I. Kubo, I. Miura, K. Nakanishi, *J. Am. Chem. Soc.* **98**, 6704 (1976)].
40. N. Abo-Khatwa and I. Kubo, unpublished results.
41. A. R. Battersby, A. R. Burnett, P. G. Parsons, *J. Chem. Soc.* (1964), p. 1187; P. Loew and D. Arigoni, *Chem. Commun.* (1968), p. 137; A. I. Scott, *Acc. Chem. Res.* **3**, 151 (1970); _____, P. B. Reichardt, M. B. Slayter, J. G. Sweeney, *Bioorg. Chem.* **1**, 157 (1971); J. P. Kutney, J. F. Beck, C. Ehret, G. Poulton, R. S. Sood, N. D. Westcott, *ibid.*, p. 194; H. Inouye, S. Ueda, K. Inoue, Y. Takeda, *Chem. Pharm. Bull.* **22**, 676 (1974).
42. C. S. Barnes and J. W. Loder, *Austr. J. Chem.* **15**, 322 (1962); A. Ohsuka, *Nippon Kagaku Zasshi* **83**, 757 (1962); T. Kato, T. Suzuki, M. Tanemura, A. S. Kumanireng, N. Ototani, Y. Kitahara, *Tetrahedron Lett.* (1971), p. 1961.
43. C. J. W. Brooks and G. H. Draffan, *Tetrahedron* **25**, 2887 (1969).
44. This antifeeding activity is suppressed by addition of an equimolar amount of L-cysteine to the warburganal test solution [W.-C. Ma, *Physiol. Entomol.* **2**, 193 (1977)]. The conjugated ene-al system of these *Warburgia* compounds may be acting as Michael reaction acceptors for thiol (SH) groups, which may be postulated to play a role in the mechanism of taste reception in these insects. It is interesting to note in passing that these four antifeedants all taste "hot" to humans, while several closely related compounds devoid of insect feeding deterrability do not.
45. D. J. J. De Villiers, C. F. Garbers, R. N. Laurie, *Phytochemistry* **10**, 1359 (1971); D. R. Adams, S. P. Bhatnagar, R. C. Cookson, R. M. Tuddenham, *J. Chem. Soc. Perkin Trans.* **1**, 1741 (1975); C. F. Garbers and F. Scott, *Tetrahedron Lett.* (1976), p. 1625.
46. A. Maradufu, A. Chapya, R. Lubega, F. Dorn, *Lloydia*, in press.
47. For example, see B. Lanzrein, M. Hashimoto, V. Parmakovich, K. Nakanishi, R. Wilhelm, M. Lüscher, "Identification and quantification of juvenile hormones from different developmental stages of the cockroach *Nauphoeta cinerea*," *Life Sci.* **16**, 1271 (1975).
48. In addition to those colleagues who have been directly engaged in the studies outlined here, we thank the ICIPE scientists and supporting staff who have devoted their time to the operation and management of this institute. We are particularly thankful to J. Jivanjee for his helpfulness. The studies described here have been supported by the United Nations Development Program (administered by Dr. W. Mashler) and by NIH grants AI 10187 and AI 12020. A grant to I.K. from the Japan Society for the Promotion of Science and an NIH postdoctoral fellowship (AI 05076) to G.D.P. are also gratefully acknowledged. Finally, J.M. thanks the John Simon Guggenheim Foundation for fellowship support.

Foreign Aid Support of Science and Economic Growth

Support of chemistry in Latin America, and scientific and economic growth in that area, are reviewed.

H. Harry Szmant

The ultimate objective of any foreign policy is to win friends and influence people outside of one's political boundaries in order to increase the security and improve the economy of one's own country. Since the advent of the postcolonial era, and especially in the case of the United States, foreign policy has become heavily dependent on foreign aid programs that were designed to raise the economic level of the less developed countries. This policy follows the premise that international support, cooperation, and friendship become meaningful when the partners share an interest in promoting a similar level of economic well-being rather than when the relationship rests only on formal pacts of friendship and mutual defense treaties. Except for foreign aid earmarked to insure national security, the bulk of foreign aid programs has been designated to provide funds for a variety of needs that create the infrastructure essential for economic growth, that is, adequate means of transportation and communications, adequate sanitary conditions and health care, the buildup of local agricultural, mineral, and energy resources, and the organization and modernization of elementary and vocational education. Because of the impressive technical character of World War II and the surge of technological contributions to the postwar economy (*1*), the support of science in the less developed countries became an important ingredient of the more recent foreign aid programs. This intent has taken a variety of forms: the establishment of educational ties between individual U.S. academic institutions and those located in the less developed countries, an exchange of visiting lecturers and research scientists, the organization of conferences, courses, and symposia, and so on. All programs also included the availability of scholarships that enabled persons from the developing countries to acquire tech-

The author is Associate Dean for Science at the College of Engineering and Science, University of Detroit, Michigan 48221.

0036-8075/78/0317-1173$02.00/0

nical education and research experience in an industrially developed environment.

In the broad spectrum of the different science areas chemistry occupies a central position (*2*) and makes the greatest direct contribution to industrial activities (*3*). The importance of the potential contributions of chemistry to economic growth has apparently been recognized by the planners of foreign aid policy and is reflected in the relatively large number of chemistry-oriented projects supported over the years by the succession of U.S. foreign aid programs. Hence, it is proper to take a retrospective and critical look at the developmental effects that were achieved through the U.S. contributions to the education and training of chemists of developing countries. Most of my discussion in this article concerns Latin America, because this region of the world has enjoyed U.S. support for the longest period of time.

Summary. The history of U.S. foreign aid support of science and technology in Latin America is examined and an attempt is made to evaluate the scientific and economic growth of that area in relation to the total foreign aid effort.

Table 1. The countries of the Western Hemisphere listed to show the members of the two free trade and market associations and the nonaffiliated countries. Guiana and Panama are included here with the nonaffiliated countries of the Caribbean area as well as Puerto Rico, which is part of the U.S. market. Data from (*26*).

Country	Population 10^{-6}	GDP ($ \times 10^{-9}$)	National income per capita ($ \times 10^{-9}$)	Energy consumption per capita percentage of United States (1973)
United States	211.9	1,415.0	6,064	100
Canada	22.5	143.4	5,449	93.9
Latin American Free Trade Association				
Argentina	25.0	34.5	1,378	15.7
Bolivia	5.5	1.9	316	1.8
Brazil	104.2	93.5	847	4.7
Chile	10.4	10.7	912	12.2
Colombia	24.0	12.4	471	5.0
Ecuador	6.9	3.7	478	2.7
Mexico	58.1	63.4	984	11.0
Paraguay	2.7	1.3	459	1.4
Peru	15.4	11.0	660	5.4
Uruguay	3.0	4.3	1,319	8.1
Venezuela	11.6	29.6	2,051	21.4
Total	266.8	266.4	1,185	
Central American Common Market				
Costa Rica	1.9	1.7	801	3.8
El Salvador	4.0	1.6	372	1.8
Guatemala	5.8	3.1	452	2.2
Honduras	2.9	1.0	306	2.0
Nicaragua	2.1	1.5	557	3.8
Total	16.7	8.9	461	
Caribbean area				
Bahamas	0.2			41.8
Barbados	0.2	0.2		9.6
Cuba	9.1			9.6
Dominican Republic	4.6	3.2	634	2.1
Guadalupe	0.4			4.4
Guiana	0.8	0.4	429	7.9
Haiti	4.5	0.7	116	0.3
Jamaica	2.0	1.9	843	13.6
Martinique	0.4			4.4
Netherland Antilles	0.2			
Panama	1.6	1.8	955	7.2
Puerto Rico	3.0	7.9	2,477	30.2
Surinam	0.4			19.2
Trinidad and Tobago	1.1	1.4		32.7
Total	28.5	17.0	800	
Grand total	312.0	292.3		

Geographical and Historical Scenario

The term Latin America is applied here loosely to mean the Western Hemisphere with the exclusion of the United States and Canada. It is noteworthy that the 300 million plus population of Latin America exceeds that of the United States and Canada and has a yearly population growth rate of about 3 percent. As indicated in Table 1, Latin America consists of a variety of countries, large and small, with a great disparity in their per capita national income and energy consumption. Analogous differences occur in the degree of chemical development in each of these countries.

The cultural interaction between Latin America and the United States was minimal before 1932 except in the case of Puerto Rico, Cuba, and Panama. The launching of the "Good Neighbor Policy" by Franklin Delano Roosevelt is a historical landmark in hemispheric relations, but its implications were political rather than cultural. Until then, Latin America looked toward Europe for the models in its educational structures and contents. In particular, Argentine scientists and students were strongly attracted to France, those from Chile and Peru to Germany and Great Britain, and so on. The relatively few individuals who came for chemical education to the continental United States were mainly from Puerto Rico and Cuba.

Two European political developments of the 1930's had a major effect on the state of chemical education and practice in Latin America: the rise of Hitler and the Spanish Civil War.

The forebodings and then the spread of Hitlerism caused some outstanding chemists to seek refuge in Latin America. Brazil was fortunate to receive people such as the team of Heinrich Rheinboldt and Heinrich Hauptmann in São Paulo in 1935 and Fritz Feigl (*4*) in Rio de Janeiro in 1940. Feigl settled in the Ministry of Agriculture and was instrumental in the mapping of the mineral resources of Brazil through the widespread application of his spot tests. Rheinboldt and Hauptmann were the founders of the São Paulo school of chemistry which continues to prosper and which has extended in recent years its salutory effects to some newer centers of chemical teaching and research of Brazil (*5*). Similarly, Rosenkrantz and Kaufmann initiated some chemical activity in Cuba but then found a more receptive environment in Mexico City. There, another refugee chemist H. Lehman, together with R. E. Marker of Pennsylvania, laid the groundwork for the com-

mercial utilization of steroidal raw materials. This venture, "Hormonas," evolved into "Syntex" under the guidance of Rosenkrantz and Kaufmann and of C. Djerassi of Stanford University. Independently, but no doubt stimulated by these commercial activities, there developed significant research in natural products that continues to flourish at the Instituto de Química of the Autonomous University in Mexico City and at the Instituto Tecnológico y de Estudios Superiores in Monterrey. Herbert Appel emigrated to Chile and was responsible for the establishment of serious chemical work at the Universidad Técnica Federico Santa María in Valparaiso, Chile.

The lengthy Spanish Civil War and the victory of Franco caused an exodus of a large number of scientists and technicians. These people had a significant influence on the teaching and practice of chemistry in Spanish-speaking Latin America, especially in Mexico, the Caribbean, and Central America. The influential Spaniard Madinaveytia actually procured the support of the Rockefeller Foundation for the beginnings of the Instituto de Química in Mexico. In evaluating the effect of the Spanish chemists on Latin America one must keep in mind that the physical scientists in Spain were rather isolated from those of Western Europe and the United States until the early 1950's, and that the research activities were not very dynamic before the Civil War in spite of some outstanding individuals such as Nobel laureate Santiago Ramón y Cajal in the biological field (*6*). The modern era of Spanish chemistry dates back only a couple of decades and was spearheaded by Manuel Lora-Tamayo.

Whereas the Good Neighbor Policy of the 1930's had hardly any scientific and technological overtones, the events of World War II awoke the official and public appreciation for science and technology and this new attitude became translated into a series of national and international aid programs.

Institutional and Regional Aid Programs

President Truman's "Point IV" program was followed by President Eisenhower's offer to aid Latin American science and technology by way of the then fashionable nuclear science program. This offer extended during the 1954 reunion of the Presidents of the Americas in Bogotá, Colombia, led in 1957 to the founding of a special nuclear training and research center in Puerto Rico under the auspices of the U.S. Atomic Energy Commission. President Kennedy gave new life to the Latin American aid programs in the form of the Alliance for Progress, and this program eventually became transmuted into the present Agency for International Development (AID). It is noteworthy that unlike the preceding programs, the range of AID's activities extends beyond the Western Hemisphere. Apart of the above programs, the United States has been a heavy contributor to United Nations Educational, Scientific and Cultural Organization, The International Atomic Energy Commission, The World Health Organization, the Pan American Union—now absorbed into The Organization of American States, The Interamerican Development Bank, The World Bank, and other such organizations that have also promoted or financed some chemical educational or research programs in Latin America. Finally, certain private foundations greatly intensified their efforts in Latin America, and while the Rockefeller and Kellogg Foundations concentrated on agricultural and medical developments, the Ford Foundation was very active in the promotion of Latin American science and technology.

Table 2. Distribution of foreign students in the United States by geographical area (*27, 28*).

Country	1975 to 1976	1973 to 1974	1971 to 1972	1965 to 1966	1957 to 1958
Africa		12,937	9,592	6,896	1,515
Europe		15,539	16,219	10,226	6,816
Far East		53,507	51,827	29,049	14,206
Near and Middle East		21,946	17,100	11,217	5,695
Oceania		2,375	2,131	1,325	495
Canada		8,747	10,395	9,755	5,271
Latin America	23,366	30,276	28,832	13,998	9,212
Cuba	276	7,932	7,612	1,280	1,046
Latin America − Cuba	23,090	22,344*	21,220*	12,718*	8,166*
Caribbean	4,549	4,773	5,059	2,686	1,385
Bahamas	676	413	336	112	86
Barbados	167	148	164	92	49
Cayman, Turks, Caicos Islands		25	22	80	
Dominican Republic	267	717	750	265	93
Guadeloupe		7	3		
Haiti	544	543	504	202	123
Jamaica	1,449	1,423	1,565	1,118	736
Leeward Islands		145	268	74	29
Martinique		5	5	4	
Netherlands Antilles	96	113	119	65	40
Trinidad and Tobago	821	853	1,006	572	183
Windward Islands		127	215	102	38
Unspecified	217	254	102		8
Central America	3,236	2,854	2,999	1,897	1,685
Belize	88	86	106	53	32
Costa Rica	371	367	391	305	203
El Salvador	441	457	440	219	241
Guatemala	278	312	350	255	288
Honduras	397	376	378	156	147
Nicaragua	551	488	491	286	244
Panama	1,095	733	833	611	530
Panama Canal Zone		18	9	12	
Unspecified	12	17	1		
Mexico	3,617	3,587	2,501	1,463	1,305
South America	11,688	11,116	10,660	6,672	3,791
Argentina	441	703	760	705	279
Bolivia	439	458	457	292	141
Brazil	1,695	1,713	1,502	772	579
Chile	711	997	932	512	234
Colombia	1,833	2,110	1,996	1,270	734
Ecuador	541	608	611	383	176
Falkland Islands		1			
French Guiana		5	3		
Guyana	781	677	892	394	193
Paraguay	74	95	84	88	34
Peru	1,335	1,474	1,459	881	387
Surinam		21	12	13	7
Uruguay	143	179	158	97	47
Venezuela	3,667	2,058	1,786	1,265	980
Unspecified	28	17	8		
Grand total		151,066	140,126	82,709	43,391

*The numbers of students from Latin America represent the following percentages of the total foreign students: 1973 to 1974, 14.5; 1971 to 1972, 15; 1965 to 1966, 15; 1957 to 1958, 19.

Table 3. Distribution of foreign students in the United States by fields of study (*27*). All numbers in parentheses are for Cuban students.

Date	Total	Science	Engineering	Agriculture	Business administration	Humanities	Social sciences	Medical sciences	Education
				Latin America					
1973 to 1974									
Total	30276 (7932)	2740 (220)	4430 (794)	896 (45)	3915 (1224)	6685 (2344)	3030 (325)	2167 (757)	1144 (291)
Undergraduate	19388 (6369)								
Graduate									
Ph.D.	708 (21)								
M.S.	1655 (43)								
Other	4885 (249)								
Special	1225 (64)								
Unknown	2415 (1186)								
1972 to 1973	28383 (6859)	2737 (281)	4890 (841)	780 (28)	4015 (1090)	5164 (1291)	3398 (370)	2047 (682)	1413 (389)
1971 to 1972	28832 (7612)	2630 (183)	4812 (841)	2599 (1700)	4316 (1195)	6045 (2006)	3359 (482)	1658 (337)	1230 (220)
1965 to 1966	13998 (1280)	1729 (108)	2816 (275)	597 (12)	1623 (151)	3671 (486)	1913 (127)	787 (17)	553 (40)
Undergraduate	8377 (792)	Chemistry 326 (28)	Chemical 393 (37)						
Graduate									
Ph.D.	779 (29)	Geology 129 (1)							
M.S.	1936 (126)	Physics 163 (15)							
Other	767 (67)	Mathematics 275 (28)							
Special	1997 (246)	Biology 783 (32)							
Unknown	142 (20)	Other 53 (4)							
1957 to 1958	9212 (1046)	827 (45)	2505 (427)	481 (22)	845 (144)	2330 (216)	780 (53)	713 (19)	329 (21)
Undergraduate	6452 (894)	Chemistry 279 (10)	Chemical 427						
Graduate	1499 (78)	Geology 111 (8)							
Special	730 (42)	Physics 88 (9)							
Unknown	531 (32)	Mathematics 71 (6)							
		Biology 278 (12)							
				Republic of China					
1973 to 1974	8416	2606	2018	230	722	810	696	328	248
Undergraduate	1688								
Graduate									
Ph.D.	1199								
M.S.	1571								
Other	3667								
Special	141								
Unknown	150								
1972 to 1973 total	9633	3158	2676	273	738	843	746	340	295
1971 to 1972 total	8703	3108	2469	250	678	760	733	231	269
1965 to 1966 total	5118	1696	1506	135	305	626	526	107	163
		Chemistry 530	Chemical 224						
		Geochemistry 60							
		Physics 319							
		Mathematics 320							
		Biology 433							
		Other 34							
1957 to 1958 total	3280	752	967	63	174	509	382	239	111
		Chemistry 353	Chemical 194						
		Geochemistry 47							
		Physics 135							
		Mathematics 91							
		Biology 126							

*The number of undergraduates in economics in 1965 to 1966 was 780, with 34 of these being Cuban.

Exchange of People Between the United States and Latin America

All of these programs stimulated the flow of chemistry students from Latin America into the United States as well as an increasing interaction of U.S. chemists with the universities of Latin America. The nature of these educational efforts by U.S. chemists varied from one Latin American institution to another, according to its needs. In some, U.S. chemists would introduce a modern laboratory-based undergraduate curriculum, in others they would teach intermediate or advanced courses, organize the science library, initiate local or cooperative research, and so on. Also, the programs stimulated the participation of U.S. chemists in the Latin American Congresses of Chemistry, the Caribbean Symposia of Chemistry, and in numerous other conferences, symposia, and workshops.

It is very difficult to ascertain accurately the bidirectional flow of people concerned with chemistry between Latin America and the United States. The statistics on the flow of foreign students into this country (Table 2) reveal that the Latin American portion has decreased from 21 percent of the total in 1957 to 1958 to a nearly constant level of 12 to 15 percent if we correct the Latin American entries for the high contingent of students identified as representing Cuba. Since 1961 the latter students are derived from the approximately 600,000 Cubans who have left their homeland, reside primarily in the United States, and are unlikely to return to Cuba. The uneven geographical distribution of Latin American students is noteworthy and reflects proximity, educational needs, cultural affinity, the economy, and the impact of specific developmental programs. Tables 3 and 4 show the distribution of Latin American students according to the level of their programs and their fields of specialization.

The traditional cultural preference of Latin American students for law, medicine, and the humanities, as opposed to the physical sciences and engineering, seems to continue and can be appreciated better if we compare the Latin American figures with the relative and even absolute figures dealing with the students from another developing and much less populated area, namely the Republic of China (Taiwan) (Table 3). The most recent comparison of the distribution of Latin American students by fields of specialization with the distribution of all foreign students reveals (Table 4) that the Latin American students still favor the study of literary subjects in preference to the (physical) sciences and chemistry, in particular. On the other hand, the relative preference of agricultural subjects by Latin American students is encouraging. In discussing the educational background of Latin American students it is important to recognize not only the Spanish majority in that area but also the Portuguese heritage of Brazil and the German, English, French, and Dutch influences in the area.

Table 4. Distribution of foreign students in the United States by fields of specialization, 1975 to 1976 (*28*).

Field of study	Percentage of Latin American students	Percentage of all students
Agriculture and natural resources	4.0	2.7
Architecture and environmental design	1.2	1.4
Biological sciences	5.6	5.4
Business and management	13.1	14.1
Communications	0.8	0.9
Computer and information sciences	1.8	2.2
Education	5.2	5.0
Engineering	18.3	20.7
Chemical engineering	2.0	2.1
Fine and applied arts	2.5	2.8
Foreign languages	2.8	1.6
Health professions	3.0	3.6
Letters	7.8	4.5
Mathematics	2.1	2.3
Physical sciences	4.6	6.4
Chemistry	1.4	2.6
Psychology	2.2	1.4
Social sciences	6.9	7.9
Theology	1.6	1.5
Interdisciplinary studies	3.5	2.6
Business and commerce technology	0.8	0.4
Miscellaneous and unknown	12.4	12.2

It is difficult to generalize about the success of chemistry students from Latin America in the United States. Those whose secondary education was patterned after the French *lycée* or the Central European *Gymnasium* usually excel in their mathematical preparation and do well in physical chemistry and other areas. Those whose secondary or previous university-level education was not shortchanged by political disturbances and educational interruptions usually also do very well. It is noteworthy that Latin American students tend to return to their homeland and, if hindered by political or economic difficulties, they usually find a position in another country of Latin America.

Latin American students adapt easily to the U.S. environment, but their comprehension of written and spoken English may often be better than their own speaking ability. One can estimate (*7*) that the total number of Latin American students who have studied in the United States between 1946 and 1973 is in the neighborhood of 300,000, and that approximately 2 percent of these were students of chemistry. This gives us an estimated minimum of 6000 Latin American chemists who received some part of their chemical education in the United States over the last 30 years.

Criteria of Growth of Chemical Activities

It is customary to expect that the size and state of health of chemistry-based, economic activities in a given country are reflected in the production of chemical publications. In 1961 there existed 29 Latin American journals of chemistry and chemical engineering among the periodicals that were reviewed by *Chemical Abstracts*. However, only nine of these were being held by 9 to 28 of the 286 U.S. libraries whose holdings were reported by *Chemical Abstracts* (*8*). The poor acceptance of Latin American chemical journals, and the fact that the more serious of the Latin American chemical researchers preferred to disseminate their results in European and U.S. publications, led in 1964 to the recommendation that a new high-level, regional journal be published in order that it might stimulate further research activity and influence favorably the quality of some of the already existing journals. The *Revista Latinoamericana de Química* began publication in 1970 under the editorship of Jesús Romo of Mexico City, and it is currently being edited by Xorge A. Domínguez of Monterrey, Mexico. The approximately 50 contributions per year that cover some 200 pages have been of high quality and represent

Table 5. Origin of contributions in *Revista Latinoamericana de Química*. General statistics for this journal are as follows: 232 papers published in 24 issues; four issues per year; about 10 to 15 papers per issue; 48 to 64 pages per issue.

Origin	Number
Western Hemisphere except United States and Canada	
UNAM (Universidad Autónoma de México, including Instituto de Química)	61.5
Instituto Tecnológico y de Estudios Superiores, Monterrey, Mexico	14.5
Instituto Politécnico Nacional, Mexico	13.0
University of the West Indies, Jamaica	12.5
University of Puerto Rico and Puerto Rico Nuclear Center	10.0
Universidad Técnica del Estado, Santiago, Chile	9.5
Universidad Católica de Chile, Santiago, Chile	8.5
Universidad de Concepción, Chile	7.5
Instituto Venezolano de Investigaciones Científicas, Venezuela	7.5
Universidad Nacional del Sur, Bahia Blanca, Argentina	5.0
Universidad de Cuyo, San Luis, Argentina	4.5
Universidade Federal de Minas Gerais, Belo Horizonte, Brazil	4.0
Universidad Iberoamericana, Mexico City	3.5
Universidade de Saõ Paulo, Brazil	3.0
Universidad de los Andes, Mérida, Venezuela	3.0
Universidad de Chile, Santiago, Chile	3.0
Universidad de Oriente, Cumaná, Venezuela	2.5
Universidad Nacional de Rio Cuarto, Córdoba, Argentina	2.5
I.M.M.S., Mexico City	2.5
Instituto Mexicano del Petróleo, Mexico City	2.0
Universidad Técnica Federico Santa María, Valparaiso, Chile	2.0
Universidad Tecnológica Nacional, Córdoba, Argentina	1.0
Universidade Federal do Ceara, Ceara, Brazil	1.0
Universidad Nacional Autónoma de Honduras	1.0
Universidad de la República, Montevideo, Uruguay	1.0
Universidad Nacional de la Plata, Argentina	1.0
Universidad de Costa Rica, San José, Costa Rica	1.0
Comisión Nacional de Energía Nuclear, Mexico City	1.0
Universidad de San Luis, San Luis, Argentina	0.5
Universidad Católica de Valparaiso, Chile	0.5
Empresa Nacional de Petróleo, Concón, Chile	0.5
Universidad del Valle, Cali, Colombia	0.5
Instituto Militar de Engenharia, Urca, Brazil	0.5
Universidad de Nuevo León, Mexico	0.5
Universidad Michoacana de San Nicolás, Morelia, Mexico	0.5
Outside of Central and South America	
Universidad de la Laguna, Tenerife, Spain	5.0
Texas Christian University, Fort Worth, Texas	4.0
University of Texas, Austin, Texas	3.0
University of California at Los Angeles	2.5
Université de Montreal	2.0
University of Notre Dame, Indiana	2.0
University of Glasgow, Scotland	2.0
Rutgers University, Camden, New Jersey	2.0
University of Florida	1.5
University of Toronto	1.0
Government College, Beawar, India	1.0
Université de Moncton, Canada	1.0
University of Virginia, Charlottesville, Virginia	1.0
University of California at La Jolla	1.0
University of Georgia, Athens, Georgia	1.0
C.S.I.C., Madrid, Spain*	1.0
William Paterson College, Wayne, New Jersey	1.0
University of Missouri, Kansas City	0.5
Western Carolina University	0.5
University of Oregon	0.5
Colorado State University	0.5
Brandeis University	0.5
Imperial College, London, England	0.5
Université Laval, Quebec, Canada	0.5
Karl Marx University, Leipzig, German Democratic Republic	0.5
State University of New York, Buffalo	0.5
University of Tasmania, Australia	0.5
University of St. Andrews, Scotland	0.5
Rochester Institute of Technology	0.5
Faculty of Pharmacy, Stockholm, Sweden	0.5

*Consejo Superior de Investigaciones Científicas.

Table 6. Topics, origin, and languages of publications in *Revista Latinoamericana de Química*.

Item	Number
Subject of papers	
Natural products	90
Organic synthesis	26
Spectroscopy	24
Physical and theoretical	24
Physical organic and mechanisms	20
Photochemistry	13
Medicinal and biochemistry	10
Analytical chemistry	8
Stereochemistry	7
Radiolysis	6
Coordination and organometallic	3
Macromolecular	1
Contribution by country	
Mexico	99
Chile	31.5
United States	22.5
Argentina	14.5
Venezuela	13
Jamaica	12.5
Puerto Rico	10
Brazil	8.5
Spain	7
Canada	4.5
Scotland	2.5
India	1
Honduras	1
Uruguay	1
Costa Rica	1
Colombia	0.5
England	0.5
Australia	0.5
German Democratic Republic	0.5
Sweden	0.5
Language of publication	
Spanish	131
English	98
French	4
Portuguese	0

Table 7. Distribution of subscriptions to *Chemical Abstracts*.

Country	Number	
	1974	1977
United States	2105	1939
Canada	148	162
Mexico	24	17
Brazil	34	34
Argentina	21	16
Puerto Rico	12	7
Venezuela	12	12
Colombia	10	4
Chile	8	7
Costa Rica	2	2
Jamaica	2	1
Uruguay	2	1
Dominican Republic	1	1
Ecuador	1	2
Guatemala	1	1
Guiana	1	1
Nicaragua	1	1
Barbados	1	1
Peru	1	1
Trinidad and Tobago	1	2
Africa	77	74
Australia and Oceania	128	123
Asia and Soviet Union	1174	1050
Europe	1785	1612
Total	5550	5071

original and modern chemical research. A survey (*9*) of the first 24 issues of *Revista* suggests (Table 5) that the majority of research is concentrated in a few laboratories, and it is apparent that several internationally known investigators located primarily in Argentina and Brazil prefer to publish in more established journals. A survey of the subject matter (*9*) of the papers points (Table 6) to the preponderance of natural product research that emanates from Mexico City and Monterrey.

The highly localized research activity is also evident from the availability of *Chemical Abstracts* in Latin America (Table 7). This "Key to the chemical literature" finds fewer subscriptions in Latin America (even with the inclusion of Puerto Rico) than in Canada, or in Australia and Oceania. The absence of several countries from the distribution of subscriptions is noteworthy and speaks for itself.

Another indicator of the relative and absolute productivity of Latin America in *all* areas of science is the data obtained from the Institute for Scientific Information's *WIPIS* (*Who is Publishing in Science*) and listed in Table 8. These numbers also speak for themselves.

Dilemma of Latin American Universities

Although there has been some progress in the chemical activities of Latin America, it is nevertheless apparent that many of the universities there have been unable to create and to maintain an environment propitious to creative work in chemistry in spite of the multifaceted and costly aid programs. Much has already been written on the dilemma of Latin American universities (*10*). In short, the pressure of the socioeconomic problems, unresolved after a century or more of independence, gave birth in 1928 to a university reform movement which spread from Argentina to the rest of Latin America. The opposition to the authoritative structure of the universities led to the principle of student participation in university government (*cogobierno*). Since few of the socioeconomic problems of Latin America were resolved or even significantly reduced since 1918, the universities continue to be highly politicized. At the same time, the traditional autonomy of the universities is being respected in spite of their nearly exclusive dependence on government funding. One finds that Latin American governments are unwilling to break with the tradition of academic autonomy and prefer to start new institutions rather than enforce an orderly and constructive educational process at the established ones.

The history of many of the universities of Latin America is that of student demonstrations and strikes that interrupt the academic functions, cause a lowering of academic standards by a vulnerable faculty, and produce a fragmentation and duplication of the academic structure. It is easy to understand that an extended institutional research effort is nearly impossible under such conditions (*11*) regardless of how much costly equipment and training may have been invested in a given university or region. Witness to this conclusion is the fact that, as fashionable scientific instrumentation changed over the past 30 years, we have seen, in succession, donations of polarographs, electron microscopes, nuclear research reactors, infrared spectrometers, and, most recently, nuclear magnetic resonance machines (*12*) sitting idly in otherwise modern, architecturally attractive buildings, while the potential researchers are distracted or even impeded from undertaking and completing any serious project.

Table 8. The numbers of publishing authors in science (1975) originating from Latin America and other selected countries and ranked by frequency of publications (*29*).

Latin America		Other	
Country	Number	Country	Number
Brazil	1,047	United States	141,314
Argentina	929	England	24,850
Mexico	696	Soviet Union	23,116
Chile	336	Federal Republic of Germany	18,411
Venezuela	234	France	16,349
Colombia	104	Canada	13,863
Peru	81	Japan	13,606
Jamaica	64	India	7,449
Uruguay	53	Australia	6,549
Cuba	45	Italy	6,482
Costa Rica	40	Switzerland	4,094
Trinidad and Tobago	36	Netherlands	3,915
Guatemala	34	Sweden	3,790
Ecuador	12	German Democratic Republic	3,650
Guadeloupe	11	Scotland	3,220
Guyana	11	Czechoslovakia	3,128
Bolivia	10	Poland	3,063
Honduras	8	Israel	2,990
El Salvador	7	Spain	1,998
Bermuda	6	Egypt	738
Panama	5	Nigeria	521
Paraguay	5	Taiwan	275
Bahamas	4	Kenya	202
Dominican Republic	4	Portugal	136
Haiti	3	Philippines	118
Nicaragua	3	Singapore	114
Martinique	2	Sudan	97
Netherlands Antilles	2	Iraq	90
British Honduras	1	Ghana	87
French Guiana	1	Zambia	84
		Bangladesh	54
		Uganda	51
		Ethiopia	42

Table 9. United States aid to Latin America, 1946 to 1971 (*30*). For the same period, the total net disbursements (in millions) to foreign nations were $138,446.2; the total net interest paid on foreign aid funds was $74,434.5; and the grand total cost of foreign assistance to 127 nations was $212,880.7.

Country	Dollars (millions)
Argentina	341.1
Barbados	0.7
Bolivia	532.0
Brazil	2,738.2
Chile	1,281.8
Colombia	1,119.4
Costa Rica	188.2
Cuba	43.7
Dominican Republic	483.4
Ecuador	296.7
El Salvador	145.4
Guatemala	355.3
Guiana	69.9
Haiti	117.2
Honduras	122.8
Jamaica	92.4
Mexico	451.6
Nicaragua	165.6
Panama	242.3
Paraguay	131.1
Peru	465.2
Trinidad and Tobago	49.7
Uruguay	184.9
Venezuela	317.6
Bahamas	31.8
British Honduras–Belize	5.9
West Indies	8.9
Total	9,982.8

Support of Individual Investigators

More successful than the massive multimillion-dollar international or U.S. programs for the promotion of chemical R & D in Latin America has been the Fund for Overseas Research Grants and Education (FORGE). Patterned after the modus operandi of the Research Corporation, New York, but adjusted to the peculiar problems of the less developed countries (LDC's), FORGE has focused its attention on the support of the individual investigator. Relatively modest grants awarded on the basis of highly scrutinized, technically sound proposals, permitted an efficient use of the money for the acquisition of the required materials and equipment without any interference from an institutional, national, or international bureaucracy. Of the approximately 175 grants that FORGE awarded between 1964 and 1976, two out of three were chemistry-oriented, and about 100 were placed in Latin America. The local opportunity for the research training of students, and the potential developmental effects of the proposed research, were top considerations in the FORGE awards. About two publications can be attributed to each FORGE grant, and the total dollar value of all of the grants distributed between 1964 and 1976 approached only $750,000. This is an insignificant amount of money when compared to the total foreign aid expenditures (*13*) of this country (Table 9) and the educational expenditures of U.S. foundations and international organizations. It is apparent that the moral and material support of the individual investigator can often overcome the otherwise discouraging and frustrating atmosphere that prevails in many universities of Latin America.

Economic Growth of Latin America

The overall small and nonuniform growth of the Latin American economy (Table 10) explains why the unrest and perturbations in the academic environment continue while, at the same time, the population pressures are continuously on an increase. Thus, the annual rate of growth of the per capita income relative to other regions of the world (Tables 11 and 12) falls very short of the dynamic development demanded by the Latin American people. To make things worse, the distribution of income is very uneven (Table 13). Thus, "in the mid-1960's half the population had an annual income of less than $125 while 20 percent had $1500 or more" (*14*). The political uncertainties of Latin America do not encourage native capital accumulated by some to stay in Latin America for long-range investments (*15*).

The output of the chemical and allied industries of Latin America accounts for less than 4 percent of the world's total (*16*) and most of the rapid growth has been limited to the large-scale production of a few petrochemicals. The infrastructure of the production of hundreds of other industrial materials is missing. The per capita chemical sales of the four chemically most active countries of Latin America—namely Mexico, Brazil, Argentina, and Venezuela—in 1970 was $32, an amount that was only one-third of that of Eastern Europe, one-fourth of that of Japan, one-fifth of that of Western Europe, and one-eighth of that of the United States.

Widespread Skepticism with Respect to Past Aid Programs

The widespread disappointment in the economic growth of Latin America was expressed during a recent conference held by the International Economic Association in Mexico City (*17*):

> More than two decades of aid projects and alliances have brought the idea of development through foreign assistance to the nadir of its popularity. Soaring promises and expectations have given way to growing criticism, cynicism and disappointment. The stunning lesson of recent history is not that economic progress has been lacking, but that whatever progress has occurred has been so very much less than the grandiose predictions that seemed to accompany every launching of every new project.
>
> Disenchantment with traditional concepts of economic aid is remarkably widespread; and while much of the criticism is undoubtedly as unthinking as was the ready support of an earlier age, the disillusionment is too pervasive to be readily dismissed as a mere fad.

Similar sentiments can be detected throughout Latin America among the rank-and-file technical personnel and others with respect to economic growth and the effects of scientific and technological research and educational activities after three decades of multifaceted aid programs.

Recommendations

To turn this situation around we must reexamine our foreign aid policy and the nature of the technical education that we offer to the students of Latin America and, for that matter, to those of other LDC's. Space limitations do not permit here a detailed discussion of this problem and of its possible solutions. The existence of the problem is widely recog-

Table 10. Growth of income per capita in Latin America, 1960 to 1970, by groups of countries. Gross domestic product (GDP) (in millions of U.S. dollars at 1960 prices). Data from (*31*), quoted by Botero (*32*).

Country	1960			1970		
	GDP	Population (millions)	GDP per capita	GDP	Population (millions)	GDP per capita
Argentina	15,810	20.9	758	22,718	24.4	934
Chile	3,769	7.7	491	5,770	9.8	590
Mexico	15,774	36.0	438	31,559	50.7	622
Uruguay	1,736	2.5	683	1,954	2.9	677
Venezuela	4,557	7.7	589	7,163	10.8	666
Subtotal	41,646	74.9	556	69,164	98.5	702
Brazil	18,468	70.3	263	32,646	93.2	350
Colombia	4,731	15.9	298	7,861	22.2	355
Costa Rica	448	1.2	364	843	1.8	469
Ecuador	1,043	4.3	241	1,713	6.0	284
El Salvador	578	2.5	230	1,026	3.4	298
Guatemala	956	4.0	241	1,597	5.3	302
Nicaragua	304	1.5	202	600	2.0	297
Panama	381	1.1	259	829	1.5	566
Paraguay	411	1.7	237	638	2.4	264
Peru	2,919	10.0	291	4,897	13.6	360
Subtotal	30,239	112.6	269	52,650	151.4	348
Bolivia	526	3.7	142	915	4.7	196
Dominican Republic	571	3.1	183	815	4.3	187
Haiti	352	4.1	85	415	5.2	79
Honduras	320	1.8	173	528	2.6	204
Subtotal	1,769	12.8	138	2,673	16.8	159
Total	73,654	200.2	368	124,487	266.8	467

nized (*18, 19*), but the analysis of the shortcomings and their solutions have been rather scarce (*20*).

One of the basic flaws of the U.S. foreign aid programs can be traced to the control exerted by macroeconomists who think almost entirely in global terms, that is, in terms of balance-of-payment problems, inflationary or deflationary pressures, and transfer of financial resources. This approach to foreign aid tends to overlook the fact that, in the long run, it is the individual who must be "developed" in order that he may function in a manner that is conducive to economic growth. Many of the administrators of the educational segments of our foreign aid programs have been made to feel that their activities were getting minimal attention and support from the top administrators (*21*) and that their projects were a form of "window dressing" designed to sell the macroeconomic package more effectively to the culturally and economically sensitive LDC's and their leaders.

Next, when foreign aid was indeed channeled into science education, little attention was paid to the question of which of the different science areas are more closely related to, or have a more direct impact on, economic growth of the LDC's. The indiscriminate (*22*) expenditure of funds on scientific activities that may be of cultural interest but that are only remotely related to the economy lend support to the suspicion that many of the educational, human resource programs are either born from innocent minds or are meant to serve public relations-oriented purposes.

Finally, when one examines the foreign aid programs in the specific area of chemistry, it is clear that hardly any effort has been exerted to build into the programs the technological and economic ramifications of that central science (*2*). The result of this practice is that the learning and research experience of the student from the LDC's produces little impact on economic growth of the country upon his return. In a way, this practice with regard to the foreign students from the LDC's is not surprising because only in recent years have we begun to inject these considerations into our own chemical education. Note the 1973 date of publication of *Chemistry in the Economy* (*23*) and the fact that only the most recent biennial conference on chemical education chose the theme of "the education of chemists for industrial needs" (*24*). The reasons that have motivated these changes in our own chemical education are even more valid when we consider the needs of chemistry students from the LDC's. Their exposure to the technological, business, and managerial aspects of chemistry is essential if we wish to stimulate the entrepreneurial possibilities and lay the groundwork for a grass-roots economic movement. The latter is needed desperately in order to supplement the massive initiatives of governments and large corporations. The suggested educational addendum should also focus the LDC student's attention on the R & D needs of his country that are not being pursued in the industrially developed countries but which are fundamental to the economic growth of his area. This is especially true if the LDC in question lacks iron, coal, or petroleum—the basic ingredients in the industrialization of Western Europe and the United States. Those of us who are anxious to see a flowering of high-powered science throughout the Third World must realize that it is unrealistic to expect this phenomenon to occur in an eco-

Table 11. Gross domestic product per capita in Latin America and selected industrialized countries (U.S. dollars at 1960 prices). Data from (*31*) and quoted in (*32*).

Country or area	1960	1965	1970	Average annual rate of growth 1961 to 1970
Latin America	368	408	467	2.4
United States	2,467	3,013	3,353	2.7
Canada	1,812	2,160	2,481	3.2
France	1,127	1,400	1,773	4.6
Italy	626	771	996	4.8
Japan	425	653	1,094	9.9
European Economic Community	966	1,184	1,466	4.3

Table 12. Growth of income per capita in Latin America. Data from (*31*) and quoted in (*32*).

1961 to 1970	1951 to 1960	1961 to 1970
	Growth above regional average	
Bolivia	1.7	3.2
Brazil	3.7	2.9
Costa Rica	3.3	2.6
El Salvador	1.8	2.6
Mexico	2.7	3.6
Nicaragua	2.2	2.9
Panama	1.9	4.6
	Growth below regional average	
Argentina	1.0	2.1
Colombia	1.4	1.7
Chile	1.1	1.9
Dominican Republic	2.6	0.3
Ecuador	1.8	1.7
Guatemala	0.8	2.3
Haiti	−0.1	0.7
Honduras	0.4	1.7
Paraguay	−0.2	1.0
Peru	2.9	2.1
Uruguay	0.6	−0.1
Venezuela	3.6	1.3
Total	2.1	2.4

Table 13. Percentage distribution of income in Latin America in 1965. Data from (*32*).

Country or area	Lower 20 percent	Lower middle 30 percent	Upper middle 30 percent	15 percent below upper 5 percent	Upper 5 percent
Argentina	5.2	15.3	25.4	22.9	31.2
Brazil	3.5	11.5	23.6	22.0	39.4
Colombia	5.9	14.3	23.1	26.3	30.4
Costa Rica	6.0	12.2	21.8	25.0	35.0
El Salvador	5.5	10.5	22.6	28.4	33.0
Mexico	3.6	11.8	26.1	29.5	29.0
Panama	4.9	15.6	22.9	22.1	34.5
Venezuela	3.0	11.3	27.7	31.5	26.5
Latin America*	3.1	10.3	24.1	29.2	33.4
United States	4.6	18.7	31.2	25.5	20.0

*Average of eight countries.

nomic and industrial vacuum. And those who believe that widespread economic growth will result automatically if scientific research is propagated throughout the economically underdeveloped world ignore the historic fact that, in the initial period of growth, science follows in the footsteps of technological activity rather than precedes it (*12*). The two develop a symbiotic relationship only in a subsequent stage of industrialization.

Thus, with regard to the foreign aid efforts of the U.S. government, foundations, and international organizations, it is time to analyze critically the cost/benefit ratio of the investments that were made since World War II and to reexamine the priorities for future programs. If we succeed in this endeavor, the people of Latin America and of the LDC's, in general, will be able to approach the 21st century with greater hopes and expectations for a better life than are warranted by the economic changes that were induced by our science support programs of the past 30 years. Certainly all those who are deeply concerned with a significant and timely economic growth of the LDC's are weary of promises of scientific and technological aid expressed by our leaders (*25*) followed by actions that prove to be quite ineffective.

References and Notes

1. H. H. Szmant, *Chem. Technol.* **6**, 152 (1976).
2. P. H. Abelson, *Science* **182**, 539 (1973).
3. There are approximately 100,000 chemists employed in U.S. industries out of a total of 350,000 scientists.
4. J. A. Schufle and L. G. Ionescu, *J. Chem. Educ.* **53**, 174 (1976).
5. A detailed account of the evolution of chemistry in Brazil was published recently by Simaõ Mathia of the University of São Paulo (*Cem Anos de Química no Brazil*, São Paulo, 1975).
6. J. Walsh, *Science* **177**, 241 (1972); J. Martinez Moreno, *Ciencia Interam.* **9**, 1 (1968).
7. This estimate is based on an average number of 7000 students between 1946 and 1950, an 8000 average for 1951 to 1960, a 14,000 average for 1961 to 1970, and an average of 21,000 students since 1971.
8. H. H. Szmant, *Informe Acerca de las Revistas Científicas y Técnicas Latinoamericanas-Química*, Grupo de Trabajo para la Selección de Revistas Científicas Latinoamericanas, San Juan, Puerto Rico (Publ. SLARC-II-6, United Nations Educational, Scientific and Cultural Organization, Paris, 1964).
9. Compiled in cooperation with Xorge A. Dominguez, Instituto Tecnológico y de Estudios Superiores de Monterrey.
10. See H. M. Nussenzveig, *Science* **165**, 1328 (1969). Also see F. Garcia Godoy, *La Problemática Universitaria Latinoamericana y la Universidad Autónoma de Santo Domingo* (Editora Cultural Dominicana, Santo Domingo, Dominican Republic, 1975).
11. Often the heroic effort of a few individuals are responsible for the continuum of scholarly work. A good example of such circumstances was Venancio Delofeu's role during the early, violent stage of Peronism in Argentina.
12. G. Hammond, *Chem. Eng. News,* **54**, 51 (19 April 1976). Also see G. S. Hammond and W. M. Todd, *Science* **189**, 1057 (1975).
13. These figures represent the total of expenditures earmarked for a given area, and only a small percentage can be attributed to educational purposes. However, if the latter is only 3 percent of the total we are dealing with an impressive amount of $300 million.
14. O. Sunkel, in *Latin America in the International Economy*, V. L. Urquidi and R. Thorp, Eds. (Wiley, New York, 1973), p. 310.
15. *Institutional Reforms and Social Development Trends in Latin America* (Inter-American Development Bank, Washington, D.C., March 1963), p. 12. The comment made here ignores the transfer of Latin American capital to countries other than the United States and to Switzerland.
16. "The world chemical economy," *Chem. Eng. News* **51**, 19–64 (16 April 1973).
17. S. W. Arndt, in *Latin America in the International Economy*, V. L. Urquidi and R. Thorp, Eds. (Wiley, New York, 1973), p. 88.
18. N. Wade, *Science* **189**, 770 (1975).
19. See J. Walsh, *ibid.*, **196**, 148 (1977). Walsh states here that: "Every Secretary of State since the 1950's has espoused the proposition that science and technology are increasingly important factors in foreign relations and that U.S. diplomacy, therefore, must have a sound technical base. The State Department, however, has been notably resistant to putting into practice what its secretaries preached."
20. See M. J. Moravcsik, J. Ziman, H. H. Szmant, *Science* **190**, 938 (1975).
21. This situation is well summarized in the following private communication from a U.S. foreign aid official: ". . . the important thing is people. People need resources to make their efforts more effective, but great things have been done by individuals even when resources were minimal. We have not been able to convince the aid administrators of this 'people concept.' "
22. Note the number of chemistry fellowships awarded by the Organization of American States during the period 1966 to 1975: Argentina, Ecuador, and Venezuela one each; Colombia, Costa Rica, Chile, and Mexico two each; and Brazil four, for a grand total of 15. In 1976 there were two chemistry fellowships (Chile and Haiti).
23. M. Harris and M. Tishler, cochairmen, *Chemistry in the Economy* (American Chemical Society, Washington, D.C., 1973).
24. "Ninth biennial focuses on preparation for industry," *Chem. Eng. News* **53**, 19 (27 October 1975).
25. Anonymous, *ibid.* **45**, 32 (27 March 1967); N. Wade, *Science* **184**, 780 (1974); *ibid.* **189**, 978 (1975); *ibid.* **192**, 869 (1976).
26. *Business International*, 5, 12, 19, and 26 December 1975.
27. Statistical data from the annual issues of *Open Doors* (Institute of International Education, New York).
28. Data by courtesy of R. E. Slattery, Institute of International Education, New York.
29. Data from *Who is Publishing in Science*, by courtesy of E. Garfield of the Institute for Scientific Information, Philadelphia.
30. Data from the Foreign Office Subcommittee on Appropriations, U.S. Congress.
31. Organization of American States Secretariat, ECLA and Latin American Demographic Center (CELADE).
32. R. Botero, *Latin America in the International Economy*, V. L. Urquidi and R. Thorp, Eds. (Wiley, New York, 1973).
33. This article is based in part on a paper presented at the Symposium on Education of Foreign Chemists in America held during the Centennial Meeting of the American Chemical Society, New York City, 4 to 7 April 1976.