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Institutional Reform and Manpower Development in Mexico

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C. E. Ayres has asserted that "the most important factor in the economic life of any people is the educational level, as we now call it, of the community. A technically sophisticated community can and will equip itself with the instrumentalities of an industrial economy."[1] Yet in the same context, Ayres recognized that formal institutions for the transmission of knowledge and belief may serve to inhibit rather than promote social progress. With unwitting prescience, he remarked, "No doubt Hindu priests and Mohammedan mullahs will resist the enlightenment of their people with all the wiles at their command, just as the Christian Church resisted the translation of the Bible from Latin into the various regional dialects."[2]

It is now generally accepted among development economists that the *functional manner* in which human resources are formed within developing societies is crucial to their ultimate capacity to become "technically sophisticated" and to equip themselves with "the instrumentalities of an industrial economy." As has been noted frequently, some of the greatest disappointments in the transfer of useful knowledge to developing countries occur when previous cultural indoctrination results in seemingly perverse behavior and frustrates the application of outwardly obvious solutions.

Societies, even when geographically contiguous, vary substantially in

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their cultural endowments, and methods of education that have been successful in fostering technological behavior are not readily transferred from culture to culture. It is one of the tasks of applied institutional economics to investigate how to make existing institutions more receptive to such educational transfers, and how the educational process may utilize progressive elements already implanted in the culture.

The case study that follows considers the educational problem in a specific social context: the evolution of the economy of Mexico during the remainder of this century. Although there have been severe vicissitudes in the country's program of economic development, the national leadership is committed to educational advancement and promotes consistent policy to enlarge the scope of educational opportunity. Yet there are deep-seated institutional obstacles that call for functional reform, and vast regional disparities in access to effective educational experience.

In 1979, the government of Mexico, under the administration of President José López Portillo, launched a Global Development Plan that projected a major transformation by 1990 in the industrial, agricultural, energy, and social sectors of the Mexican economy.[3] Since President López Portillo's successor in office, Miguel de la Madrid Hurtado, was a principal author of the global development plan, it is contemplated that the new administration will sustain the essential objectives of the program. Vital to the success of this program are the formation of an adequate pool of educated and skilled workers and technicians capable of carrying out the manifold enterprises comprehended by the global plan, and at the same time, the formulation of a domestic science and technology policy that will support its long-range goals.

The global development program places great emphasis on decentralized growth, and thus one of its worker training objectives must be to reduce regional inequalities in access to education and in the functional content of what is taught in the schools.

Demographic Aspects of Educational Opportunity

In 1978, 46 percent of Mexico's population was under 15 years of age (as compared with 24 percent in the United States).[4] Projections made by the Latin American Demographic Center (CELADE) indicate that the proportion of this age group in the population is not likely to drop below 41 percent by the year 2000.[5] The Mexican National Council for Science and Technology (CONACYT) has estimated that the school-age population included between the ages of 5 and 24 increased by 18.7 million between 1960 and 1980, reaching a figure of 34.9 million by 1980—roughly

equivalent to the entire 1960 population.[6] Providing free universal education for so large a number, even though many never reach secondary or higher levels, has been reasonably successful only in the metropolitan zones.

As recently as 1975, scarcely 30 percent of the entire country's male population 30 years and over, which constitutes a highly significant segment of the labor force, had completed more than four years of primary schooling and could be considered fully literate.[7] CONACYT points out, however, that the average figure is very misleading. In the Federal District, Baja, California, and the northern zone comprising Nuevo Leon, Tamaulipas, Coahuila, and Sonora, the portion of male adults with four years of schooling reached 50 percent, while in the less developed states of Tlaxcala, Hidalgo, Zacatecas, San Luis Potosí, Tabasco, Guerrero, Oaxaca, and Chiapas, it did not exceed 15 percent.

Federal expenditures on education, and therefore relative educational opportunities, are strongly affected by the vigorous trend toward urbanization and urban concentration in the country. By 1970, Mexico was one of the most urbanized of the developing countries, and its rate of urban population growth between 1940 and 1970 was among the highest in the world.[8] In 1940, only 20 percent of the Mexican people lived in places with 15,000 or more inhabitants.[9] By 1970, 45 percent were living in such centers. Much of the growth has been concentrated in three cities: Mexico City, Guadalajara, and Monterrey.

Mexico City is clearly the dominant magnet for migrants from other parts of the country. The great metropolis absorbed 54 percent of the internal migrants between 1960 and 1970, and the children born to migrants contributed almost as much as the migrants themselves to the growth of the city during that decade.[10] As a consequence, the densely populated zone comprising the Federal District and the adjoining urbanized area in the state of Mexico was estimated to reach 13.6 million persons in 1980, and at the present growth rate is projected to attain 31.7 million in the year 2000.[11] Such a projection, however, rests upon the questionable assumption that it will be ecologically feasible to sustain so large a population in one metropolitan zone and that more attractive growth poles do not materialize within the next two decades.

Guadalajara, whose estimated population in 1980 reached 3.5 million, is projected on the same basis to grow to 5.1 million by 2000, and Monterrey, with an estimated population of 2.9 million in 1980, is projected to reach 5.6 million by the end of the century.[12]

It is not generally appreciated that along with this strong trend toward urban concentration (as well as a large but inadequately measured flow

of Mexican migrants to the United States), the number of small and medium-sized cities ranging between 15,000 and 100,000 inhabitants also has grown considerably during recent decades In 1970, there were 143 of these cities spread widely throughout the country, and if the Global Development Plan is to achieve its goal of decentralizing economic activity within the country, such places must become increasingly attractive locations for migrating populations and must offer corresponding educational and employment opportunities.

The National Industrial Development Plan, which forms part of the global program, provides for eleven regionally dispersed development zones.[13] Four of these will be new industrial ports, now under construction at Tampico and Coatzacoalcos on the Gulf of Mexico and at Lázaro Cárdenas and Salina Cruz on the Pacific Coast. The government offers tax credits and tax rebates to encourage new investment in these development zones, and offers investors in the industrial ports further incentives to locate there in the form of a 30 percent discount in the prices of electricity, natural gas, fuel oil, and basic petrochemicals by the government agencies that supply them. In order further to diversify industry and provide local employment, the plan provides for a 10 percent discount on the cost of natural gas for investors who locate outside the designated development zones but in proximity of the new cross-country gas pipeline.

The emphasis on decentralization in the Global Development Plan is also reflected in the Mexican Food System (SAM) announced by President López Portillo in March 1980 as an ambitious program to increase domestic food production and raise agricultural productivity.[14] The program set targets to achieve national self-sufficiency in corn and bean production by 1982 and in rice, wheat, soy beans, and sorghum by 1985.

These target periods are exceedingly short. For the staples of general consumption, the SAM goals require that the annual production of corn must increase from 9.6 to 13 million tons, and the bean harvest must double to 1.5 million tons within a period of two years.

As compared with other Latin American countries, Mexico had an excellent record of raising agricultural productivity and total output beginning in the late 1940s and continuing through the 1960s, but most of the gains were accomplished within large-scale commercial farming. A combination of factors, including severe droughts as well as bureaucratic inertia, has slowed the progress of earlier years. Under the SAM program, much of the burden of increasing food production will fall on small farmers who now grow crops mainly for their own subsistence. The success of the program will therefore require the voluntary cooperation of large masses of peasants with very little education, and this poses formidable

tasks for local technical training and for communication between the centers of agricultural research and the users of improved farming methods.

Technical and Higher Education

To achieve its goals for trained workers in technical fields, Mexican public and private education will necessarily have to place more emphasis on vocational and professional schools, as well as on higher education generally. Under the administration of President Luis Echeverría Alvarez, these levels of education expanded vigorously. During the period from 1970 until 1975, Mexico established more than 800 new technical secondary schools.[15] This represented more than three times the number existing in 1970, and the schools served 530,000 students, more than twice the 1970 enrollment. In 1975, 50 percent of the secondary technical institutes were privately operated; they accounted for 30 percent of the students in such schools.

Nevertheless, CONACYT observed that only about 20 percent of the total number of secondary school matriculants are enrolled in technical schools, and this proportion "is still inadequate to meet the country's needs. Furthermore, this insufficiency not only appears in quantitative, but also in qualitative terms, such as shortcomings in the curriculum, deficient instructor preparation, and at times, insufficient laboratory equipment."[16]

Mexico has also made great strides in the expansion of higher education. Between the 1970–71 and the 1975–76 academic years, university enrollments virtually doubled, from 251,000 to 500,000 students, representing an annual rate of increase of 14 percent.[17] New institutions were created so that each state had its own university, and the dominant National Autonomous University of Mexico (UNAM) was joined by a smaller rival, the Metropolitan Autonomous University (UAM), with three campus locations established in Mexico City. In addition, the number of technological institutes controlled by the Secretariat of Education was expanded from 22 to 48.

Unfortunately, the growth in private employment opportunities during the Echeverría period did not match the rapid increase in university graduates, and the universities became a sort of shock absorber to keep students from entering the ranks of the unemployed. According to a report by an association of rectors of public and private institutions of higher education (ANUIES), "Given the impossibility of obtaining a decent job, tens of thousands of young people have entered higher education looking for not only more training, but also a social identification that is more attractive than that of 'unemployed'. . . . The difference between the cost of

creating a job and the cost of creating a place in the educational system explains, in part, the rapid growth of the educational system. But this attempt at containment is no solution to the problem, rather only a temporary palliative that will end in underemployment and more social unrest."[18]

Reacting to the financial crisis of 1976, the López Portillo administration initially restricted spending on education, but began to stress innovations that would raise the standards of admission to the universities and train students in fields more closely related to the development needs of the economy. The Secretariat of Education created a terminal vocational school program designated as CONALEP, which is intended to divert as much of the demand for higher education as possible. Six schools have been built under this program, and twenty more are planned.

At the same time, entrance examinations were established for students seeking to enter the UNAM from secondary schools not directly associated with a university. In 1979, according to Noel F. McGinn and Susan L. Street, "UNAM crowded 75,000 students into its football stadium for the application of its admission examination; 30,000 were denied admission to the university."[19] In a further effort to relieve some of the pressure on its main campus, UNAM created five branch campuses, from which students cannot readily transfer to the central university. These branches comprise National Schools of Professional Studies (ENEP), which grant degrees for specialized curricula.

In March 1980, the Subsecretariat of Higher Education announced a new National Plan for Higher Education, which forms part of the Global Development Plan, to extend until 1990. Essentially, the plan poses that some 140 institutions of higher education compete for funds by filtering their requests through a complex pyramidal structure of three layers of interest groups and governmental coordinators. (State and federal governments provide about 90 percent of the funding for universities in Mexico.)

As seen by the Secretariat of Education, the underlying motive for so vast a plan is to rationalize the past discriminatory allocation of funds for higher education. McGinn and Street point out that "universities in the Federal District receive much more subsidy per student than do those in the provinces. UNAM receives about 40 percent of the total for about 25 percent of the students, but there is no evidence available to show that the quality of instruction at UNAM is better than at the state universities. Per student costs vary considerably from program to program and university to university. There are no established accounting procedures."[20]

The machinery established for allocating the higher education budget

seems unduly cumbersome, as it requires each university, after determining its internal needs, to submit its budget to a state-level planning committee composed of representatives of state and federal governments and the universities, professional associations, business (the productive sector), unions (the social sector), and cultural groups. Then the budget is presented to a regional planning council made up of representatives from state and federal governments and the universities. Finally, a committee composed of ANUIES and the Secretariat of Education coordinates university budgets nationally.

Yet the individual plans developed by the universities are only indicative, as each university is free to ignore guidelines laid down by the Secretariat of Education and to fall back on the traditional method for obtaining federal support—direct and individual petitions to the Secretariat.

There is thus little assurance that the National Plan for Higher Education will meet its primary aim: the formation of human resources specifically related to the requirements for social development. As President López Portillo has said, "Higher education principally has to link itself with the occupational system with the objective not of forming professionals for frustration, but rather persons capable of locating or generating their own sources of work."[21]

Particularly missing from the educational plan is a comprehensive program for developing the research function of universities and establishing national and regional priorities for the types of investigation to be stimulated in relation to the industrial and agricultural development plans.

The Mexican educational establishment faces the same problem of an excessive concentration of educational resources in the principal metropolitan zones at the elementary and secondary levels. Per capita expenditures vary substantially from state to state and the poorer states are particularly deficient in provisions for teacher training, so that rural teachers sometimes enter their classrooms with little more formal schooling and educational maturity than the children given to their care.

According to CONACYT, "The content and quality of secondary education, in general, are still not satisfactory. Teacher training is inadequate and full-time teachers practically nonexistent, since they are paid on an hourly basis. This, together with the low level of salaries, encourages teachers to work an excessive number of hours. The result is poor class preparation and little updating in the subjects. The recent effort by the UNAM to establish a category of special career teachers at the high school level (teachers who would be able to count on a certain number of paid hours for preparation) is directed towards solving this problem."[22]

The Pedagogical Content of Technical Education

In a modernizing, industrializing society, it is essential that pedagogical methods keep pace with the requirements of an economy in which employment is no longer governed by tradition but by newly emerging opportunities and new demands on human creativity. Education, rather than concentrating on preserving the cultural values of the past, must become increasingly functional, and, in the words of John Dewey, "instrumental in the solving of novel problems." The role of functional education is to create a forcing bed in which the acceleration of experimentation, innovation, and adaptation becomes a normal process.

Wide variation exists within Mexico in elementary teaching methods, ultimately the base for later technical training and for the work attitudes that farmers, industrial workers, and service employees bring to their jobs. As in most Latin American countries, where the system of primary education was strongly influenced by the catechistic methods of the church, the prevalent mode of instruction in Mexico has been rote learning. It is a common experience when one visits rural schools to hear children chanting in unison at the teacher's direction.

So ingrained is this method of instruction that it reaches to university levels. "University teaching," reports CONACYT, "despite some efforts to change the situation, basically relies on systems which require students to passively assimilate information and which do not awaken an inquisitive attitude which would encourage the student to question, investigate and experiment. There are several factors which indicate that the educational and professional levels of university graduates are deteriorating. This phenomenon is associated with a decline in the preparation of university professors and the growing demand for higher education."[23]

In a country emerging from conditions of widespread rural and urban poverty and from a traditional specialization of artisan crafts and industries in local villages and even family guilds, the burden of diversifying childhood experience falls more heavily on formal education that it does in a wealthier society where children have more time and opportunity for play, the exercise of idle curiosity, and informal education. There is a profound cultural difference between children who grow up in most parts of Latin America and those in the United States in the degree to which the latter begin in infancy to play with what have come to be known as "educational" toys. These include geometric building blocks, jigsaw puzzles, and simple tools that teach the pre-literate child relationships and instrumental forms of manipulation while the eyes and hands are still gaining coordination. These are followed through adolescence by the Tinker Toy,

the Erector building kit, the chemistry set, the home-made radio, and often the personal microscope and astronomical telescope before the child finishes high school. The typical North American childhood, quite outside the formal educational system, is littered with artifacts to excite the curiosity, to be manipulated and understood, and to be used with some end in view. This environment is, of course, made possible by the pre-existence of an industrial culture and by the wide diffusion of higher incomes, and it is actively promoted by commercial interests.

Since the advent of the Deweyan revolution in education in the United States, with its emphasis on "learning by doing," the process of informal education has been deliberately reinforced in the formal education system by the use of what is often called the "inquiry" method. In the better high school laboratory, sciences are taken quite seriously as preparation for more intensive study at the undergraduate and graduate levels in the university.

This manner of growing up is a powerful conditioning factor in predisposing intelligent and creative young people to continue working with their hands as well as their minds, thus to enter highly demanding scientific and engineering fields as a challenge rather than with a fear of lifetime attachment to the workbench.

In Latin America, most children are not exposed to similar instrumental circumstances and challenges because of low incomes and limited industrial development. But even among upper income groups, social aspirations have generally given preference to the professions—traditionally the law, medicine, and literature—with the result that the universities have, until very recent years, been weak in science and engineering. Mexico is now catching up, and in order to provide a foundation for the expansion of science and technology at the level of higher education, it is necessary that *formal* education provide many of the experiences afforded by *informal* education in wealthier countries.

Happily, Mexico has within its rich cultural tradition an educational movement well designed to fulfill this function. The basis for this movement was laid by the Swiss educator, Enrique C. Rébsamen, in the state of Veracruz beginning a century ago.[24]

Rébsamen was a disciple of Johann Heinrich Pestalozzi and, like him, believed that children learn best by using their own senses and by discovering things for themselves. At that time this was a novel idea in most countries, including Mexico, and one that antedated the Deweyan revolution in education in the United States. Rébsamen thought of education as a functional process in which pupils should be exposed directly to the materials, plants, and animals of their natural environment from their earliest

years. They were taught to appreciate these elements as features of natural history, as sources of esthetic satisfaction, and as materials for practical use. Thus prepared, children were expected to make better functional use of the resources at hand in their own communities.

Rébsamen attached to his classrooms an array of shops and laboratories in which children worked with their hands in the arts, crafts, and sciences. Additions to rural schools were built by the children themselves under the guidance of their teacher-craftsmen, and each school was surrounded by gardens, orchards, and livestock pastures as a self-sufficient enterprise. Rébsamen's principal achievement was the founding of a normal school at Jalapa that has perpetuated and recently given a rebirth to his educational principles, so clearly related to the needs of a developing economy.

Although they professed an enthusiasm for the promotion of science and technology, the national educational leaders of his era, the celebrated *científicos*, vitiated interest in Rébsamen's approach in that they displayed no genuine interest in popular education or the advancement of the Mexican lower classes.[25] The influential Positivist movement concentrated on order and progress derived from abroad. President Porfirio Díaz, a mestizo himself, stood in awe of the ingenuity of foreigners and permitted them almost exclusively to direct the expansion of railroads, silver mines, and petroleum fields, giving scant employment opportunities to the indigenous and mestizo population except as menial workers. Thus few educational foundations were laid for an effective participation by Mexican craftsmen and technicians in the development of their own resources.

After the bloodiest period of the Mexican revolution in the early 1920s, its leaders sought to consolidate their gains under President Alvaro Obregón. Obregón boosted popular education by giving an ample budget to his energetic minister of education, José Vasconcelos, who had great confidence in the capacities of the indigenous peoples. Vasconcelos began a vigorous campaign against illiteracy, and within four years established almost one thousand new schools in rural villages.[26] These were of a new type, which he called *Las Casa del Pueblo* (The House of the People). They featured basic education in reading, writing, arithmetic, and folk culture, but they also stressed practical instruction in sanitation, scientific agriculture, and other useful arts. Vasconcelos's famous *anexos* provided for the education of adults as well as children and sought to make the school the village cultural center through the introduction of electric lighting, sewing machines, mills for grinding corn, and other useful equipment that would ensure the support of the adult villagers thus benefited.

Aside from intense resistance in many villages from the *cacique* and the *curandero*, the local chieftain and the medicine man, Vasconcelos's prin-

cipal problem was to find teachers who were themselves literate and who had the versatility and political skill necessary to effect a social transformation. The isolation of the villages and the general poverty militated against popular education, but the foundations were laid. Later, in the 1930s under President Lázaro Cárdenas, Mexico undertook an ambitious plan to select the brightest adolescents from every village and send them to the National School of Agriculture at Chapingo. Graduates were expected to return to their own villages and instruct their compatriots in improved methods of farming, using the local dialect or language. Some rural students succumbed to the bright lights of Mexico City and never returned, but others became the new leaders of rural Mexico.

The Mexican revolution in popular education, although sometimes hampered by a contentious bureaucracy that has maintained traditional methods in many districts, marches on. It is particularly vigorous in Veracruz, where the Escuela Normal Superior Enrique C. Rébsmen has produced hundreds of dedicated teachers whose mission is to bring functional education and practical versatility to the most remote corners of the state. Many of these schools can be reached only on horseback, and villagers must bring in building materials on their backs. Often the initial teaching must be in the indigenous idioms of Maya, Nahuatl, or Totonaco before the children can be weaned to the common instructional language of Spanish.

It is impressive to visit the local post offices before the beginning of each school term and find them filled with textbooks labeled "The Property of the Mexican People." Critics of these government-issued books have at times charged that they are written for ideological indoctrination rather than genuine education. Yet it must be borne in mind that these were the first free and readily available textbooks ever to reach the hands of masses of Mexican children. It is at this level that popular education must still begin in much of rural Mexico and in many impoverished districts of marginal settlers in the larger cities. Only as well-stocked school libraries become available will it be possible for those who have barely learned to read to sort out and compare ideas from a diversity of sources.

In the coming period, Mexico will have an exceptional opportunity, in comparison with many other developing countries, to infuse its national educational system with the best pedogogical methods derived from its own cultural experience. The Rébsamen method, which trains children from their earliest years in the practical arts and crafts, while simultaneously emphasizing their scientific and esthetic aspects, could be widely generalized as a means of breaking down the regional disparities in educational opportunity. Vasconcelos's conception of the local school as the

center of community life also lends itself to widespread adaptation. Undoubtedly there are other discoveries in effective education that can contribute to the social transformation now taking place.

A Science and Technology Policy for Development

In addition to laying a broad base in popular education for a future generation increasingly attuned to a technological society, Mexico has the opportunity to create, at the highest level, a comprehensive program for domestic science and technology that will be closely related to its primary development needs.

The basis for such a program was laid in 1970, when CONACYT was established. After several years of collaborative study by three hundred Mexican scientists, educators, and administrators, CONACYT produced in 1976 an extensive blueprint for the development of domestic science and technology through 1982. The major objective of the National Indicative Plan for Science and Technology was to develop, within the shortest possible time, a national capability for both technological self-reliance and the contribution of technological activities to the attainment of economic, social, and cultural development objectives.[27]

The plan set forth budgetary goals as well as allocations for decentralized geographic and sectoral distribution of research and development institutes. The plan also defined objectives of raising the level of educational attainment, increasing the number of full-time investigators, and distributing Mexican scientific and technical manpower by sector and type of research, basic or applied. These priorities were set following a comprehensive survey of existing educational and scientific resources and were specifically intended to remedy disparities in the national distribution of such facilities uncovered by the survey.

Unfortunately, the plan fell victim to the national financial crisis of 1976, late in the administration of President Echeverría. Under the succeeding López Portillo administration, the focus of CONACYT's activities was shifted to relatively short-range objectives relevant to the immediate needs of the National Industrial Development Plan. These objectives were embodied in the new National Program for Science and Technology presented in October 1978.[28] This program has been criticized as providing merely a fiscal framework for financing relatively uncoordinated research projects and scholarships, with no clearly defined priorities or plans for systematic institution building.[29]

However, at a recent international symposium on planning for development held in Mexico City, it was pointed out that the current Global De-

velopment Plan strongly implies a need for a corresponding promotion of domestic science and technology with emphasis on development priorities. Víctor L. Urquidi, president of El Colegio de México, called for a re-examination of the provisions and implementation of CONACYT's 1976 Indicative Plan with new long-range perspectives to the year 2000, taking into account the financial resources that had become available since the plan was first proposed.[30]

In broadening its scientific base, the Mexican educational community can take advantage of its own successful experience in long-term scientific and technical development of agriculture. The country benefited greatly from the advances in genetic and horticultural research introduced after World War II that for a time made Mexico a world leader in the Green Revolution. A cooperative arrangement made in 1943 between the Mexican Ministry of Agriculture and the Rockefeller Foundation in the United States provided expert outside assistance for the promotion of domestic agricultural research and the application of its fruits to practical farming. Twenty years later this program emerged as the world-famous International Center for the Improvement of Maize and Wheat (CIMMYT), whose success has led to the establishment of similar regional centers for the improvement of other food crops in the Philippines, Colombia, Peru, and elsewhere.

The concrete results of Mexico's agricultural research programs are impressive. In the period from the 1930s to the 1960s, Mexico was able to increase its corn yields per hectare of land by 52 percent, and for a time reached self-sufficiency in this staple foodstuff of the general population.[31] The improvements in wheat yields were even more spectacular. In the period 1935–1939, the level of Mexican wheat yields was below those of the United States and Argentina, but by 1960–1962, average yields exceeded those of both countries. Mexico actually trebled its output of wheat per hectare between 1948–1952 and 1964–1965. As a consequence, the country was able in some years to export appreciable quantities of wheat, although dry years later interrupted the established trend in improved productivity. The development of extensive irrigation systems contributed to the growth of agricultural output, but according to Montague Yudelman, an international authority on agricultural development, "there can be little doubt that one important factor in these differential growth rates in corn and wheat yields has been the sustained high quality of research in producing new varieties of wheat and corn in Mexico and the United States."[32]

What can we learn from this successful instance of scientific collaboration between Mexico and the United States that can be applied to other fields?

It was of crucial importance that the initiators of the project assembled a staff of investigators trained in the pure sciences of genetics, microbiology, and plant pathology in outstanding universities, and who were also sincerely interested in applied horticulture—and that their research was initially financed at a critical level permitting sufficient resources to be applied for effective results.[33] Second, while the research began with fundamental information produced in other countries and borrowed breeding techniques, the process was soon domesticated as native plant stocks were collected and the selective breeding process was conducted under localized environmental conditions within Mexico. Third, the plan from the beginning was for a team of foreign (chiefly U.S.) and Mexican scientists to create a truly self-sustaining research center with close ties to the international sources of new knowledge, whose interchange benefits all such institutes. During the first twenty years about 250 of the most proficient interns in the research program were sent abroad for specialized education, and most of them are now working in Mexico. A major factor discouraging a brain drain from Mexico was the establishment of a system of rewards and support facilities that made a full-time scientific career in Mexico an attractive opportunity for young Mexicans.

Not only did Mexico become self-sufficient in food production during the first two decades of the agricultural research program, but Mexican scientists in CIMMYT, now an autonomous international research center, have innovated their own ideas and added to the world storehouse of useful knowledge, as significant applications in Southeast Asia and in other parts of Latin America demonstrate.

Notwithstanding, as the CONACYT report points out, there are still gaps in the transmission of applicable information from the considerable number of Mexican agricultural research centers (of which CIMMYT is only one) to farmers at the production level, particularly in subsistence areas.[34] As in most parts of Latin America, systems of extension education are less effective than in countries with advanced agricultural practices, and more attention needs to be given to ways of establishing better communication. Rural education of the Rébsmen type can play a role in making agricultural extension work better.

The Need for Institutional Reform

The development of a strong educational and scientific base is indispensable to the success of Mexico's Global Development Plan. Such a base requires reduction of the wide interregional disparities in both income and basic educational opportunities that now exist within the coun-

try. Bureaucratic rivalries at all levels of government, extending to widespread corruption, and an excessively cumbersome educational hierarchy will no doubt continue to delay the progress that could otherwise be made.

Nevertheless, it should be clear that within its own cultural diversity, its previous efforts in scientific and applied fields, and its long-standing relationships with educational institutions in the United States, Mexico has a store of experience that could be generalized to much wider effect. The challenge of the coming growth period is to create institutional reforms that will enable the Mexican people as a whole to participate effectively in the new technological era at hand. This task will have to be performed by Mexicans themselves, as they seek to equip themselves with "the instrumentalities of an industrial economy."

Notes

1. C. E. Ayres, *The Theory of Economic Progress* 2d ed. (New York: Schocken Books, 1962), p. xxi.
2. Ibid., p. xxiv.
3. The core of the new program, the National Industrial Development Plan, was announced in March 1979, followed by a full elaboration of the Global Development Plan in April, 1980. Estados Unidos Mexicanos, Secretaría de Patrimonio y Fomento Industrial, *Plan Nacional de Desarrollo Industrial, 1979–82* (Mexico, D. F., March 1979); Poder Ejecutivo Federal, Secretaría de Programación y Presupuesto, *Plan Global de Desarrollo 1980–82* (Mexico, D. F., April 1980).
4. "1978 World Population Data Sheet" (Washington, D.C.: Population Reference Bureau, March 1978), p. 1.
5. Centro Latinoamericano de Demografía, "America Latina: Indice de Crecimiento de la Población en el Período 1950–2000," *Boletín Demográfico* (Santiago, Chile, 7 January 1974), p. 13.
6. Consejo Nacional de Ciencia y Tecnología, *National Indicative Plan for Science and Technology* (Mexico, D. F.: Editorial CONACYT, 1976), p. 55. Hereafter referred to as CONACYT.
7. Ibid., pp. 55–56.
8. Arthur Silvers and Pierre Crosson, *Rural Development and Urban-Bound Migration in Mexico* (Washington, D.C.: Resources for the Future, 1980), p. 15.
9. Luis Unikel, Crescencio Ruiz Chiapetto, and Gustavo Garcia Villareal, *El desarrollo urbano de Mexico* (Mexico, D.F.: El Colegio de México, 1976), p. 27.
10. Silvers and Crosson, *Rural Development*, pp. 22–23.
11. Robert W. Fox, *Urban Population Growth Trends in Latin America* (Washington, D.C.: Inter-American Development Bank, 1975), p. 87.
12. Ibid., p. 87.
13. Estados Unidos Mexicanos, *Plan Nacional*, pp. 155–72.

14. Alan Riding, "Mexican President Emphasizes Farming," *New York Times*, 9 April 1980, p. A9; Abelardo Martín and Carlos Ferreyra, "El SAM, esfuerzo totalizador," *Uno Más Uno* (Mexico, D. F.), 6 August 1980, pp. 1, 7.
15. CONACYT, *National Indicative Plan*, p. 57.
16. Ibid.
17. Roberto Arizmendi Rodríguez, "Políticas de la educación superior" (Paper presented at the first Inter-American Congress on Educational Administration, Brasilia, Brazil, 10–17 December 1979).
18. Asociación Nacional de Universidades e Institutos de Educación Superior, *Planeación de la educación superior en México* (Mexico, D. F.: ANUIES, 1979).
19. Noel F. McGinn and Susan L. Street, *Higher Education Policies in Mexico*, Institute of Latin American Studies Technical Papers Series, no. 29 (Austin, Texas: University of Texas at Austin, 1980), p. 4.
20. Ibid., p. 5.
21. The statement is from President López Portillo's third presidential address and is quoted in Carlos Muñoz Izquierdo, "Hacia una redefinición del papel de las educación en el cambio social," *Revista Latino-americano de Estudios Educativos* 9 (Mexico, D. F., Winter 1979): 131–50.
22. CONACYT, *National Indicative Plan*, p. 57.
23. Ibid., p. 57.
24. Juan Zilli, *Historia de la Escuela Normal Veracruzana* (Tacubaya, Mexico: Editorial Citlatepetl, 1961), pp. 9–82.
25. Although a free compulsory primary education law was passed in Mexico in 1891, on the eve of the Revolution in 1910 the Mexican literacy rate was still only about 20 percent. David Felix, "On the Diffusion of Technology in Latin America" (Paper presented at the Conference on Diffusion of Technology and Economic Development, Bellagio, Italy, 21–26 April 1973), p. 54.
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