

ON THE VIABILITY OF A POLICY FOR SCIENCE AND TECHNOLOGY IN MEXICO

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During the National Conference on Education, Science, and Technology, held in June 1976 as part of the political campaign just prior to the change of administrations, the spokesman for the Consejo Nacional de Ciencia y Tecnología (CONACYT) stated, in the presence of the incoming president of Mexico, that:

It is presently impossible to doubt the need for a policy on science and technology in Mexico. Such a policy should not base the country's scientific and technological development upon the never-ceasing imitation of the research lines and technological solutions of the advanced countries. It is necessary for us to look for our own model of scientific and technological development.

With regard to science, this model would require that, without isolating ourselves from international scientific developments and without adopting patterns of research that are beyond our reach, we attempt to achieve levels of excellence in areas that are inadequately dealt with in the research carried out by the industrialized world but that constitute priorities for Mexico. The general objective of scientific policy should be the rapid development of a research capacity that would permit the scientific community to fulfill its social functions within a framework of academic freedom, to participate increasingly in the universal scientific process, to disseminate science, to contribute to the preparation of human resources, to support technological development, and to act as society's conscience. . . .

With regard to technology, adoption of our own model would imply a sustained, planned course of action tending to strengthen both our capacity to select, negotiate, assimilate, and adapt foreign technology and to design our own technologies for areas to which little attention has been paid by the advanced countries' technological research but which are relevant to and of great interest for a country like our own: in the process of development, with diverse climates, and with abundant unskilled human resources. . . .

In order to develop Mexico's capacity for self-determination in technological matters and to ensure technology's contribution to the achievement of the goals of national autonomy, socioeconomic and cultural development, and a more equitable distribution of income, it is necessary to strengthen CONACYT's continued efforts, particularly at a time in which the bases for long-term planning in science and technology are being established.

Furthermore, for a science and technology policy to give results, its strategies must be designed not for six years, but for twenty to twenty-five years. The

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planning task that CONACYT has been coordinating has been organized in this way. Only in this temporal framework is it possible to develop national plans and programs of action (covering both one-year and six-year periods) for science and technology. Considering the gestation period for science and technology and our degree of underdevelopment, a national plan for science and technology that lacks a long-term perspective runs the risk of being a meaningless exercise.¹

On the basis of these criteria, CONACYT presented the National Plan for Science and Technology to both the outgoing president of Mexico and the president-elect in November 1976. After the new government took office, nothing more was heard of the plan, and a significant number of the members of the scientific community (including some who had been given the National Award for Science) expressed their regret that CONACYT's new authorities had forgotten about it.

About six months after the change in administrations, and in the context of a symposium on science in Mexico organized by the Academy of Scientific Research, concern became widespread about the lack of continuity that, during the past twenty years, had led to the failure of scientific research and technological development programs that had been financed and encouraged by the federal government. Critics insisted that in Mexico—with the exception of the efforts that had led to the development of important civil engineering technology during Alvaro Obregón's administration (1920–24) and to the accumulation of the impressive stock of petroleum technology following the establishment of the Mexican Petroleum Institute in the early 1960s—there had never been any coherent or systematic policies for research and technological development. Similar opinions were voiced persistently over a period of almost two years (although criticism was less frequent among the directors of higher education institutes and professional technological associations), and by the end of 1978 there was an impressive body of negative feelings towards CONACYT's performance.² There are many who would claim that no other public agency has been so severely criticized during the present administration.

While the rather brief and confusing national debate regarding the failure of the first attempts at designing science and technology policy in Mexico under the Echeverría regime petered out—without having produced any results—towards the middle of 1978, analytical interest in Mexico's experiences continued abroad as the result of the widespread international diffusion of the National Plan for Science and Technology.³ Thus, it may be worthwhile to ask whether it is possible at all to implement a reasonably coherent, long-term science and technology policy in a developing country such as Mexico.

It is worrisome that, in the opinion of the majority of national and

foreign observers, the task does not seem viable.⁴ If, as it seems, it is not possible to isolate science and technology policy from the institutional aberrations and discontinuities that result from the Mexican six-year political cycle then, in spite of the current widespread availability of financial resources derived from petroleum exports, Mexico may not achieve autonomy in a field whose long-term importance can be compared only with that of political independence.

It must be emphasized that with the exception of a small group of top scientists and technologists, consensus has not yet been reached in the country on the need to plan and program scientific and technological activities. It was only towards the end of the past administration—and as a result of the work related to the National Plan for Science and Technology—that the first signs of such a consensus were emerging. The fact that this process was interrupted by the change in administrations was not due to any one person nor to any particular group. It was the result of a complex interplay of forces among groups with short-term political and economic vested interests, in a society in which there is not as yet a true awareness of the crucial role that science and technology play in the process of development.⁵ This sort of awareness will not evolve easily since Mexico is in many respects an underdeveloped country with an inefficient educational system, a small and weak scientific-technological elite, and a long tradition of anti-intellectualism that derives in part from the colonial period and in part represents one of the social costs of the Revolution.⁶

Thus, there are today, as there were in 1976, many Mexicans—both among the science and technology users and among bureaucrats—who deny the need for a science and technology policy that would go beyond some public funding for research and for sending graduate students abroad.⁷ Neither is there a shortage of people who, taking radical political positions, maintain that it is not feasible for Mexico to develop any degree of autonomy in its science and technology policy because all countries of the “capitalist periphery” are condemned to be dependent in this and other fields.⁸ Both groups seem to agree basically that it is impossible for Mexico to organize and direct scientific and technological affairs with a certain degree of rationality and in accordance with the overriding necessities of the country. The difference between the two groups lies in the fact that while the first enjoys scientific/technological dependency or lives off it, the second considers dependency to be inevitable.

The first working hypothesis underlying this essay—that Mexico does not have a scientific/technological policy—is supported by the fact that there is not only no evidence of its presence (which was apparent

during Mexico's participation at the U.N. Conference on Science and Technology for Development in Vienna, August 1979), but also that its absence has been admitted by the present CONACYT authorities.⁹ The second hypothesis, that the formation of any coherent policy in this field is not viable in Mexico, can be defended by analyzing CONACYT's activities during the past eight years, even without being a detailed study of the complaints made by scientists, technologists, and educators regarding the current behavior of this agency.

It should be pointed out that the tasks that CONACYT carried out between 1971 and 1976 were not limited to the attempt to develop a national policy for science and technology. They included a significant number of initiatives and measures that, on the one hand, tended to strengthen the science and technology infrastructure of the country with regard to diffusion, information, statistics, equipment and instrument imports, and technical norms, and, on the other, tended toward the establishment of permanent links between science and technology and the educational and production systems.¹⁰

Since the economic/financial crisis of fall 1976, many of these activities have been suspended, substantially reduced, or allowed to stagnate (like the research centers established in the provinces during the previous administration). For example, while CONACYT's magazine, *Ciencia y Desarrollo*, continued to be published after the change in administrations, of late it has been dedicated primarily to the diffusion of scientific and technological advances in the developed countries, as if the national elites would not have access to international progress in this field due to language barriers.¹¹

At the same time the recent document (substituting for the earlier *National Plan*), *The National Program for Science and Technology, 1978–1982*, not only has little to say about the planning tasks defined previously, but it has all the characteristics of a poorly organized directory of several thousand research projects. They seem to be linked only by the fact that it occurred to someone in Mexico to undertake such projects or that it was thought that it might be interesting to set them in motion.¹² It is public knowledge that the final version of the *Program* has not even been submitted to the scrutiny of the scientific community as a whole, even though its members had responded to CONACYT's surveys made in 1977 and 1978.

An evaluation of the state of science and technology was made for UNCTSD (Vienna, August 1979),¹³ but the absence of statistics on national science and technology expenditures, its sectoral distribution, government participation in the total funding, the cost of technological imports, national expenditure on human resources, development, etc., makes it impossible to form an opinion on its content. At the same time

a footnote from this "national monograph" asserts that "in 1977 the number of people involved in scientific research in Mexico, included 12,254 Mexicans, 2,409 foreigners and 2,328 technicians"(?). Unfortunately, this information does not inspire much confidence since the statistics give considerably higher figures than those which were carefully prepared by the *National Plan* in 1976.

Furthermore, considering that, between 1977 and 1979, no information on CONACYT's overall budget and the magnitude of its financial support for research had been published (while the scholarship program received a great deal of publicity), it is reasonable to conclude that the radius of CONACYT's activities has been circumscribed primarily to the program for human resources training. This has been financed partially by credit from the Interamerican Development Bank by virtue of an agreement reached towards the end of the previous administration. According to statements made by its present authorities, CONACYT employed eight hundred people in August 1978;¹⁴ thus the financial and social cost of this scholarship program would seem fairly high. However, whatever the costs, scholarship programs and the diffusion of international scientific progress are just two of the many aspects of a national policy for science and technology. Up until the present, such a general integrated policy has been neither redefined nor implemented.

When analyzing the reasons behind these developments, it is useful to remember that the founding of CONACYT towards the end of 1970 ("as advisor and assistant to the Federal Executive for the establishment, instrumentation, execution and evaluation of national policy for science and technology"¹⁵) took place in a very special setting, which explains many of the recent problems faced by the institution. First, CONACYT's functions and its field of action had not been clearly defined at the time (nor were they defined in 1975 during the congressional revision of CONACYT's bylaws). Second, CONACYT had been provided originally with considerably more political power than that held by many other decentralized agencies. This power contrasted, however, with the limited size of its financial resources, which has not allowed CONACYT really to influence the science and technology activities of the country.¹⁶ Thus, between 1971 and 1976, the council lived largely as a result of its being viewed favorably by Mexico's president who, at the same time and in contrast to his particular style of governing, intervened very little in CONACYT's activities.

The president's benevolent attitude during CONACYT's formative phase permitted the agency, between 1973 and 1976, to undertake a number of activities (such as the creation of new research centers) without the interference of the federal bureaucracy. The four secretaries of

state, members of the board of directors and well acquainted with the president's attitude, adopted a position of extreme tolerance towards CONACYT. The rest of the board members—the rector of the National Autonomous University of Mexico (UNAM) and the director general of the National Polytechnic Institute (IPN)—were natural allies of the recently created agency. However, from an *ex post* perspective, it is clear that this constellation of political forces was both circumstantial and temporary.

Moreover, while this situation offered great immediate advantages, it presented serious long-run drawbacks. Setting in motion a coherent science and technology policy in any country—but particularly in an underdeveloped one—depends not only upon the benevolence of the head of state (as powerful as he might be), but also—and most importantly—upon the degree of support coming from those responsible for the operative control of financial, educational, industrial, and agricultural policies, among others. Such support is particularly necessary if, as in the case of Mexico, these policies themselves are not too well coordinated.

While the need to integrate science and technology policies with economic and social ones had been stressed repeatedly in the three successive versions of the National Plan for Science and Technology, this central objective went unnoticed during the scant public discussion that followed publication of the plan in November 1976. Unfortunately, the final document appeared at the worst possible political moment: half-way through the brief period that separated the devaluation of the peso on 1 September 1976 and the change of administrations on 1 December of the same year. This may well have been the reason that no one noticed the two warnings the document contained regarding its great limitations: first, that the plan had been drawn up in the absence of a national strategy for development and, second, that it referred only to the first phase of a long term exercise.¹⁷

Both at the National Conference on Education, Science and Technology in June 1976 and at all of the other relevant occasions during the final phase of the outgoing administration, the spokesmen for CONACYT (starting with the then director general) insisted that any serious planning for science and technology should be closely linked to the strategy for socioeconomic development, and that by definition the process of planning in this field was never-ending. They proposed that the process of scientific and technological planning in Mexico include four phases: (1) the formulation of the strategy for the scientific and technological development of the country within a long-term perspective (twenty to twenty-five years); (2) the definition of the national policy for science and technology with an intermediate perspective (ten years);

(3) the formulation of successive national indicative plans for science and technology (six-year periods); and (4) the formulation by the scientific and technological community of research programs and projects, at both an institutional and a sectorial level, for the duration of each indicative plan. These ideas were the results of an exercise in which not only some two hundred and fifty outstanding representatives of science, technology, education, and the national productive sector participated voluntarily for three years, but—also as volunteers—some of the top experts from different parts of the world.¹⁸

The term “planning” occupied the position of prime importance among the many functions of CONACYT outlined in its bylaws, but it only appeared as its primary objective in July 1974, three and a half years after the agency’s founding and two years prior to the de facto political end of the administration (coinciding with the election of the new president). Although by the beginning of 1973 CONACYT had gathered together a group of experts to draw up the initial analysis of the science and technology system and to formulate some preliminary suggestions regarding a national policy for science and technology, these first studies were carried out independently of the agency.¹⁹ The political framework necessary for CONACYT’s entry into the area of planning was provided by the personal style of governing practiced by the then president of Mexico. First, the initiative for a plan originated expressly with the president; second, this initiative was announced at a working meeting of the CONACYT and not a meeting of its board of directors or at a higher level governmental forum; third, the secretaries of state, members of CONACYT’s board of directors, participated only formally in the decision. In this way, the special political position of both CONACYT and of the future National Plan for Science and Technology was confirmed.

It is well known that the apex of the Mexican political system is composed of a series of personal bilateral relations of varying intensity between the head of state and “his collaborators” (the ministers and the heads of all major public agencies and all sorts of presidential advisers as well). Thus, work on the National Plan for Science and Technology started in a way that was perfectly normal in Mexican political terms. In this case, however, this “normality” was somewhat excessive since it involved the initiation of a process of policy formation that extended beyond—and by definition it had to—the duration of one administration. Consequently, the adoption of “normal” political procedures also had a high political cost. Since CONACYT had not engaged in specific political negotiations with the other important ministerial-level collaborators of the president, only a tacit general nonintervention pact

emerged within the government with regard to science and technology policy.²⁰

Although the nonintervention pact worked fairly well up until the change of government, what was needed during both the 1970–76 administration and the subsequent one was something much bigger: the clear-cut support and cooperation not only of the ministers but also of the intermediate levels of the federal bureaucracy. During the formulation of the plan, this kind of support was forthcoming only on the part of the secretary of the treasury, which was not sufficient in the light of the deepening financial crisis; it was destroyed by the devaluation of the peso and the “austerity measures” subsequent to 1 September 1976 events.

Although the attempt at science and technology planning initiated in 1974, was, at the political level, a fairly isolated process, at the operative level it was possible to obtain the cooperation of almost all the groups and sectors directly or indirectly involved in scientific and technological affairs. This widespread cooperation is only comparable to the process of science and technology planning that was carried out in India a few years earlier. CONACYT’s activities passed through four stages: (a) between June and December 1973, *The Bases for the Formulation of a Policy for Science and Technology in Mexico* were drawn up; (b) between July 1974 and September 1975, *Guidelines for a Policy on Science and Technology in Mexico (1976–1982)* were elaborated; (c) between October 1975 and June 1976, *National Policy for Science and Technology: Strategy, Guidelines and Goals* followed; and (d) between July and October 1976, the final document, the *National Indicative Plan for Science and Technology*, was prepared.

It should once again be emphasized that each of the three successive preliminary documents (*Bases*, *Guidelines*, and *Policy*) were formulated and discussed in great detail by some two hundred and fifty scientists, technologists, users of science and technology, and public sector officials. This great mass of collaborators was organized into four scientific committees, ten sectoral committees, four technological/sectoral working groups, and two ad hoc groups established to study, respectively, the organization of the national science and technology system, and the existing technological policy instruments. Moreover, the *Bases* were discussed among experts from seven countries and four continents. *Guidelines* and *Policy* were approved by two advisory commissions—one on science and the other on technology policy—in which thirty institutions, responsible for 80 percent of Mexican scientific and technological research, participated. Finally, as can be seen in the introduction to the final version of the *National Plan*: “after careful revision of *Policy* document the scientific and technological community accepted

the perspective, strategy and general objectives of the document and proposed the modification of some of the sectorial objectives and guidelines, modifications in both the general and sectorial diagnosis texts and additions to or reorganization of some sections (all of which were included in the final document)."²¹ Since the *Plan* also received the formal support of the National Commission for Science and Technology Planning at the ministerial level,²² and was received with interest and approval by both the outgoing and newly elected presidents of Mexico, it would seem that its implementation by the new administration was assured. However, as the events of 1977–78 demonstrated, the consensus surrounding science and technology policy contained in the *Plan* was more apparent than real.

Five groups—with well-defined and sometimes conflicting interests—participated in the plan's formulation: scientists, technologists, educators, the federal bureaucracy, and members of Mexico's private sector. In order to assure high quality work, and not simply adequate institutional representation, the leaders of the different committees or working groups were free to invite the most knowledgeable representatives of different sectors of the scientific and technological system, as well as experts from the different fields of science and technology, to participate. While the institutional aspect was covered by the two advisory commissions and the national commission at the ministerial level, CONACYT concerned itself primarily with the theoretical aspects of the planning venture and with the search for the information required by the working groups. This emphasis was due to the fact that in 1974 there was no conceptual framework for science and technology policy in Mexico, while information on research activities was superficial, fragmentary, and unreliable.

Over two years of intense activity within CONACYT was needed to draw up a conceptual framework that reflected the position of science and technology in the country and to formulate a fairly accurate analysis of the relationship between scientific and technological activities and the educational and productive system. The disaggregation and the evaluation of the results of the science and technology census carried out in 1973 were particularly complicated and arduous. It was found that part of what was considered scientific and technological research in Mexico actually had very little to do either with science or technology even when these terms were generously defined.²³

The analysis available in 1975 revealed that:

a. the scientific and technological system depended to an inconvenient and inordinate degree upon the development of science and technology in the highly developed countries, and was frequently lim-

ited to merely imitative activities in areas of research of great importance to Mexico's future;

b. there were insufficient financial resources, not only in comparison with the developed countries but even in comparison with countries at the same level of development (like some of the larger Latin American republics);

c. in both quantitative and qualitative terms, the system counted on insufficient human resources in comparison (in absolute terms) with many other countries at a similar level of development;

d. there was excessive geographical and institutional concentration: in 1973, the research institutes located in the capital and surrounding areas controlled more than 80 percent of the national spending and personnel connected with scientific and technological activities, and five large organizations received 45 percent of the available funding;

e. the expenditure on science and technology was poorly distributed in functional terms—almost 70 percent of the financial resources went into salaries, and less than 15 percent into buying material and equipment, the adequate availability of which is indispensable for serious research;

f. the majority of the research institutes suffered a critical lack of researchers—only 3.5 percent of the institutes had more than twenty research projects of some relevance under way, involving multidisciplinary approaches;

g. science and technology advancement was clearly discontinuous and reflected the neglect of very important areas of research. Resources for applied research and experimental development were concentrated in a few sectors where governmental participation had been particularly intense. Petroleum and energy, agriculture, medicine and health, and the intermediate goods industry absorbed half of the financial resources available for research. Even in these areas, research was insufficient and inadequate to the scientific and technological needs of the country. On the other hand, areas of great future importance were neglected, such as research into certain aspects of agriculture (e.g., cattle and forestry), nonrenewable resources, the capital goods industry, transportation and communication, urban development and housing, etc.;

h. permanent ties between research and the educational and productive systems were extremely weak. The structure of the national science and technology system fostered the separation of research from the increasingly dynamic and technologically complex productive activities. CONACYT's responsibility for the dissemination and diffusion of science and technology had not been really developed and this limited its cultural and educational impact. The weakness of technical diffusion

and extension services constituted an obstacle to the transmission of the knowledge to the productive sector; this situation was especially obvious in noncommercial agriculture and in the consumer goods industries.

There were those who, after analyzing the figures given by CONACYT, UNAM, and IPN, insisted that the productivity of the Mexican science and technology system was even lower—in both quantitative and qualitative terms—than suggested by CONACYT, and that it could not measure up to the productivity of countries like Brazil, India, or Israel.²⁴ Even without examining the details of CONACYT's analysis of the state of science and technology in Mexico (formulated between 1974 and 1976) it was already evident that it was impossible to fight this underdevelopment with scholarship programs or an increase in the financing of research projects alone.

The complicated process of creating consensus in favor of a long-term scientific/technological policy between 1974 and 1976 met with great difficulties. Vested interests and conflicting viewpoints were behind much of the initial weak support for planning. Moreover, there was a noticeable lack of awareness of the relationship between science and technology on the one hand, and development on the other, or of the reasons for a science and technology policy. Furthermore, each of the major group actors was concerned only with its own immediate problems: representatives of exact and natural sciences defended the freedom of research, which they considered endangered by the supposed pragmatism of the planners; social scientists showed deep concern about political interference on the part of the government through the future plan; technologists worried about the general low level of technological education and the lack of interest in technological innovation on the part of enterprises; educators were worried by the quantitative explosion and qualitative deterioration of the educational system as a whole; middle-level bureaucrats were almost completely involved in preparing for the change in administrations; and private businessmen were primarily interested in lowering the costs of imported technology. In fact, with the exception of the Mexican Petroleum Institute, a few executives of medium-size firms, and national engineering and consulting firms, involvement of the federal bureaucracy and the public and private productive sector in the plan's formulation was fairly marginal.

The participation by scientists in the science and technology planning of 1973–76 did not escape controversy and friction either. It is worthwhile to recall the essence of those conflicts, however, since the few who have defended the plan after the change in administrations were members of that group. First, scientists were afraid of an increase in bureaucratic interference in their activities. This fear was well-founded

in the day-to-day experiences of Mexican research institutes and in the rather unsuccessful contacts established between the scientific community and CONACYT immediately following the founding of that agency. At that time, its first, inexperienced managers tried to orient research towards undefined "relevant ends." However, the process of mutual learning, in which CONACYT's planners and scientific leaders from UNAM, IPN, and autonomous research institutes participated, led to tangible benefits for all those involved. This was expressed in mid-1978 by a biologist of international reknown, Dr. Ruy Pérez Tamayo:

From the very first talks that the coordinators of the working groups had with the authorities of CONACYT, we realized that the official philosophy was clearly a pragmatic one; in other words, there was a utilitarian, pro-development concept of science that both underlined and fostered those aspects applicable to education and culture. Fearful that such a perspective would prevail in the final version of the National Plan, the researchers from the working groups on biological sciences and physical-mathematical sciences carried out a campaign to convince CONACYT's authorities that a purely pragmatic position restricted to "science for development" might even be counterproductive in terms of their own objectives. I can say with satisfaction that our views were listened to and that the definitive version of the Plan was much less pragmatic in nature than was the initial one.²⁵

Another, perhaps even more serious, problem was the result of the way in which the Mexican government finances scientific and technological activities. Public funding involves a tangle of bilateral institutional relationships between the federal treasury and the administrators of the principal higher education and research institutions. These relationships have been tinged by a high degree of political and personal considerations that form part and parcel of the more general political behavior of any national treasury. The treasury in Mexico has always been particularly sensitive to the political position of the different federal ministries, the public agencies subject to budgeting controls, and the federally subsidized institutions like the universities.²⁶

The political complexity of the budget allocation process makes access to public funding exceedingly uncertain and sometimes unfair. As the *Plan* pointed out, in the case of public expenditure on science and technology, not only "are the mechanisms of financing characterized by unnecessary multiplicity and complexity" but "almost all these mechanisms lack explicit criteria for decision making, and thus, decisions are taken on the basis of very short-term political considerations, whose application generally results in a slow and contradictory development of scientific and technological activities."²⁷

Faced by a general lack of understanding and in the absence of criteria for scientific and technological policy, the academic and research

institutions' budgets are usually determined by treasury authorities on the basis of the amount approved for the previous year. Care is taken that the new amount be neither less nor significantly greater, and that increases in the budgets of institutions with scant negotiating capacity not be approved. These criteria—as the final document of the *Plan* demonstrates—have constituted the bottleneck in the growth process of many research institutes that were supposedly set up to cover some key gap in knowledge that could not be left unfilled. As a result of budgetary restrictions and difficulties (among other things), many of these institutes were unable to fulfill their objectives.

Additional difficulties derive from the fact that in both the public sector (the federal ministries and the decentralized agencies) and the universities, research expenditures have to be negotiated internally prior to the negotiation of the overall institutional budgets with the treasury (and, since 1977, with budget authorities). In this way, science and technology activities are constantly at a disadvantage when competing with the financial needs of other segments of the public sector and higher education. These disadvantages increase especially when the budget is subject to restrictive policies since the amount allocated for science and technology are the first to be reduced due to a lack of awareness of their importance on the part of both treasury administrators and the rest of the state bureaucracy, and of a sizeable segment of the university bureaucracy as well.

As a result of certain administrative reforms initiated in 1974–75, which introduced the technique of program budgeting for public expenditures, CONACYT created the concept of a national budget for science and technology, and attempted to convince the research institutes that it would be to their own advantage to negotiate their annual budgets jointly. It was thought that the notion of a national budget was absolutely necessary because its acceptance by federal authorities would oblige them to comply with the annual targets for public spending on science and technology. Otherwise, it was thought to be impossible to assure a continued and relatively organized expansion of the scientific and technological system and the rapid improvement of needed human resources.²⁸

However, these attempts to establish national accounting for spending on science and technology faced a lack of interest on the part of the middle-level bureaucracy within the ministry of the presidency and the ministry of national patrimony and in the large academic institutions that, like UNAM, have considerable negotiating strength with respect to the treasury. To complicate matters further, suspicion arose—unfounded though it was—in some segments of the scientific commu-

nity that the purpose of the proposal was to make the research institutes more dependent upon CONACYT through its supposed control of the national budget for science and technology.

In these circumstances the tenuous coalition formed by CONACYT and the scientific/technological community only once came out in joint defense of a long-term national policy for science and technology. This occurred some weeks after the publication on 28 September 1976 of the presidential decree regarding the austerity program for the treasury after the peso devaluation.

This was, however, more of an attempt to ease the severe impact of the 1976 economic crisis upon the finances of the research institutes, than it was a campaign in favor of planning. Taking advantage of the opportunity that arose from the secretary of treasury's invitation—prior to the devaluation—to draw up the budgets for 1977, twenty-five institutions that had cooperated in preparing the National Plan (among them UNAM, IPN, El Colegio de México, the Mexican Petroleum Institute, the National Institute of Agricultural Research, the National Institute of Nutrition and the National Center for Productivity) sent the federal government—through CONACYT and the secretary of treasury—a memorandum that stated, *inter alia*:

The scientific development and technological self-determination of Mexico presupposes an active policy of support for science and technology on the part of the state and the inclusion of scientific and technological activities among those of highest priority.

The National Plan for Science and Technology has established the goals for the next six years in the area of financial effort and human resources. In spite of their preliminary character, these goals (drawn up with the widespread participation of the scientific and technological community and of high level representatives of the federal government) reflect the real needs of Mexican science and technology, as well as the capacity for absorption of financial resources and the potential availability of high level human resources. In this situation the Mexican scientific and technological community considers these goals to be *attainable* and insists that they *cannot be postponed*.

According to the National Plan, it is necessary that national spending on science and technology (which is estimated at 5,400 million pesos at 1975 prices, for 1976) continue to grow during the next administration at a real annual average rate of about 20%. Only in this way will the proportion of national spending on science and technology increase from 0.52% of gross domestic spending in 1976 to something more than 1% in 1982 (the minimum considered necessary for developing countries).

Mexican scientific and technological institutes are conscious of the fact that the country is going through a grave economic and financial crisis. However, they consider that the present situation not only demands solidarity among all Mexicans, but that it also urgently requires the precise definition of national priorities (distinguishing between the long-term and short-term ones and not sacrificing the former to the latter). Considering that science and technology are of prime importance, they cannot be subordinated to the needs of the moment.

They are activities that by their very nature and their cumulative character are basically different, for example, from public works projects. While in certain circumstances some public works or infrastructure projects can be postponed without causing any harm, a research program cannot be suspended because such a move might nullify all earlier efforts.

While it is possible to rationalize spending and to increase productivity in any field, the national system of science and technology needs to count on growing financial resources year after year—at the annual rate proposed by the National Plan for Science and Technology—for four main reasons:

- a. the strategic role of science and technology in development;
- b. the scientific and technological backwardness of the country;
- c. the fact that research activities, by their very nature, do not lend themselves to unilateral administrative-financial decisions, even in an emergency situation; and
- d. the need to comply with the commitments made by the government itself or its representatives in the field of international scientific and technological cooperation.

In view of the above, the scientific and technological research institutes hope that the authorities responsible for the formulation of the federal budget for 1977 provide them with financial resources in accordance with the financial goals that correspond to that year (as established by the National Plan for Science and Technology). This is the only way to avoid the great danger of stagnation and the possible reduction of the scientific and technological activities in the immediate future in areas as strategically important as agriculture, food, capital goods industries, energy, etc. Moreover, it must be taken into account that in the field of science and technology, Mexico must not lag behind Argentina and Brazil (whose development in this field is much greater than that of Mexico).

It is sufficient to say that under its second Plan for Science and Technological Development, Brazil spent an equivalent of 10,780 million pesos in 1976. This was twice as much as Mexico spent that same year in spite of the fact that Brazil's per capita income is less than that of Mexico.²⁹

As far as it is known, the institutions which signed this memorandum have not received even a formal reply. Not only was the country sunk into an economic and financial crisis (and the outgoing administration was no longer functioning) but also, on the eve of the government's change, the topic of science and technology lost its appeal to the upper political echelons in favor of administrative reform. As a result, each institute had to arrange its own 1977 budget bilaterally, as best it could, and accept the consequences of the austerity measures. Moreover by December 1976 (with the change in administrations), the concept of planning science and technology, the idea of the national budget, and the related public spending goals had been all but forgotten within the newly named CONACYT.³⁰

In June 1977, six months after the change of the government, representatives of the scientific community still had all the reasons to be extremely concerned with the incessant application of budgetary austerity with regard to science and technology. When they visited the new presi-

dent of Mexico, however, the importance of continuing CONACYT's earlier work on national science and technology planning and budgeting was conveniently forgotten. At their meeting at the Palacio Nacional, the National Plan for Science and Technology was not even referred to in spite of the fact that the majority of the scientists requesting the president to instruct appropriate agencies to draw up a national program for scientific research had participated in the formulation of the now forgotten plan.³¹ In this way the cyclical political process of "forgetting" the earlier attempt to establish the bases for a long-term national policy on science and technology drew to a close.

At the beginning of this essay two hypotheses were put forth to explain the course of events related to science and technology planning in Mexico. The first suggested that, given the working of the political system, a reasonably coherent and long-term national policy for science and technology is hardly viable. According to the second hypothesis the interruption and apparent destruction of the first attempts made between 1973 and 1976 to set up a coherent and long-term policy were not the work of any one person or group but was the result of a complex interplay of forces among groups with conflicting short-term economic and political interests operating within a society in which there was still no awareness—at any level—of the crucial role that science and technology play in making development a more independent process. The evidence so far presented offers convincing proof that the failure of the National Plan for Science and Technology was not only the result of the economic and financial crisis of 1976 but was also the consequence of the institutionally destructive aspects of the six-year political cycle in Mexico. The resulting institutional demolition processes constituted the final blow to the National Plan.

Paradoxically, one of the best analytical explanations of what had happened in Mexico was developed abroad. It was formulated by a former official of the Argentine CONACYT, Eduardo Amadeo, as a part of an evaluation of the first decade of activity of the National Science and Technology Councils in Latin America.³² According to Amadeo, the basic error of all these agencies lay in their managers' belief that Latin American societies and political systems respond almost automatically to rational policy planning for science and technology at the national level. However, with the exception of Brazil (which seems to have a long-term national policy that is something akin to "manifest destiny") this has not been the case. To set into motion a national policy for science and technology, adequate perception of its importance by the state bureaucracy, the scientific community, and both the public and private

national productive sectors is necessary. Without this awareness, Latin America's CONACYTs were doomed to failure.

These observations are supported by the experiences of the Mexican CONACYT, experiences which are perhaps the most convincing because they demonstrate the functionally counterproductive way in which Mexico's six-year political cycle operates. It is enough that a president of Mexico become—for reasons of his own—an innovator in a certain field and for the next president—in his search for a personal style of governing—to abandon these innovations in favor of others. To complicate things even more, in the face of growing numerical demand for high and intermediate-level government jobs in a country characterized by a demographic explosion, the political feasibility of sustaining continuity at the intermediate level of command, from one administration to the next, is progressively reduced. The results of the rapid and forced rotation of the state bureaucracy at all levels are obviously lamentable in the case of science and technology policy.

The absence of a long-term policy for science and technology in Mexico is particularly regrettable at a time in which the country is just entering the initial phase of the petroleum boom. A weak internal scientific and technological capacity seriously restricts the application of the financial resources derived from petroleum to economic development and social transformation. This restriction cannot be eliminated through massive imports of foreign technical know-how, as has been demonstrated in the cases of Venezuela and Iran.

There is an even more serious problem, however, that springs from the nature of the present relationships between science and technology on the one hand, and the process of socioeconomic development on the other.³³ Traditionally these interrelationships are thought to be simple and unidirectional. It is also believed that once the general goals of development have been defined it is possible—through policy and institutional arrangements—to structure the scientific and technological systems of a country in such a way as to facilitate and accelerate the pursuit of these goals. However, the present interrelationships among science, technology and society are much more complex since the process of development, its direction, and its goals are strongly influenced by the extremely rapid international evolution of scientific and technical knowledge. The latter tends to become the decisive element in the conceptualization and general perception of development, and constitutes the dominant force behind development policy and its results.

There is growing evidence that the countries that import the majority of the science and technology they utilize in their development process are highly affected by the impact of the knowledge and the

know-how originated in the advanced countries. The imported technological models influence their economic systems, their paths of development and their internal socioeconomic relationships. The impact tends to be particularly marked in societies that, like Mexico, live next to a great, albeit declining in relative terms, center of scientific and technological power.

It is especially important in this type of situation to be able to count on some organized way in which to influence the totality of the interrelationships among science, technology, and development, relationships that suffer sudden, and sometimes unexpected, changes. However, observing these relationships and correcting any problems that may arise depends upon the prior designing of science and technology policy, the efficiency and competence of the agencies responsible for implanting such a policy, and the ability of those responsible for science and technology policy to remain on the sidelines in the fight for political power.

Mexico seems to be facing at the same time a predominance of knowledge imported in a disorganized manner without reference to any social criteria; a weakness in adaptive capacity and internal innovation (with the exception of the large private industrial enterprises and a small number of the large public enterprises); and a lack of well-established links between the scientific, technological, productive, and educational systems. In this situation, science and technology management in a casuistic and partial manner, within a framework of separate policies designed for different "systems" or "sectors," increases (instead of diminishes) the existing restrictions and difficulties.

Both theory and available evidence indicate that the application of policy instruments designed to supervise science and technology advancement and correct their path as soon as problems arise may be necessary. Such corrective action may be needed at different stages of the incorporation of knowledge into the productive activities: when know-how is imported; when local scientific knowledge and technological know-how is being fostered; or when the explicit transformation of the knowledge and know-how into goods and services takes place. However, any such effort will be unsuccessful when disorganized socioeconomic development is accompanied by the random import of technological advances reflecting private choices. Consequently, the absence of a policy for science and technology inevitably leads to the concentration of the benefits of development and of scientific and technological power, additional weakening of the already weak internal capabilities and the increase in social tensions in spite of the wide availability (in the case of Mexico) of petroleum resources.

The fear that this might occur was perhaps what led an outside

observer of Mexico's recent difficulties with the planning of science and technology to conclude his analysis of this subject with the following observation: "Now when the winds of the great financial crisis of 1976 have calmed down and when income from energy resources begins to increase, perhaps the appropriate conditions for long-term actions will once again develop and at least some portion of the impetus and guidance provided in the National Plan for Science and Technology will be salvaged."³⁴ Unfortunately, there is no evidence to this effect. The most recent Comprehensive Development Plan (May 1980) gives only cursory attention to science and technology problems.

NOTES

1. National Conference on Education, Science, and Technology, Mexico, June 1976. Institute of Political, Economic, and Social Studies of the PRI.
2. Among other sources, consult Salvador Malo, "Cuando la leche es poca al niño le toca," *Naturaleza* 7, no. 6(58), Dec. 1976, and "Suerte te dé Dios mi hijo, que el saber poco importe," *Naturaleza* 8, no. 1(59), Feb. 1977; Enrique Daltabuit, Rene Drucker-Colin, Augusto Fernández Guardiola, Salvador Malo, Antonio Peña y Ricardo Tapia, "Un análisis de la actitud del gobierno respecto a la ciencia en México," *Naturaleza* 8, no. 3(611), June 1977; José Warman, "La ciencia mexicana: vuelo sin instrumentos," *Nexos*, no. 1 (Jan. 1978); Carlos Larralde et al., "Saber no es poder: temas de la ciencia aplicada en México," *Nexos*, no. 2 (Feb. 1978); Ruy Pérez Tamayo, "La investigación biomédica en México: espejismos y prioridades," *Nexos*, no. 6 (June 1978); Joseph Hodara, "El intelectual científico mexicano: una tipología," CEPAL, June 1977 (mimeographed). Also consult newspaper reports on the Symposium on Science in Mexico, Academy of Scientific Research, 9–10 June 1977; the visit by scientists to the Palacio Nacional, 13 June 1977; and the seminar on the situation of science in Latin America and its relationship to society's problems, UAM-Xochimilco, 4 October 1977.
3. Towards the end of November 1976, an English version of the National Plan was distributed to the several hundred research centers for scientific and technological planning in both the advanced and developing countries. This was in recognition of the interest shown by these centers in the plan's preparation in the course of the extensive institutional and personal contacts established by the CONACYT between 1973 and 1976. As a result of this measure, the plan was the subject of discussion in numerous universities and research centers in the United States, Europe, and Latin America in 1977 and 1978. Consequently, the plan has been discussed much more abroad than in Mexico itself.
4. Among other sources, see Dilmus D. James, "Mexico: Recent Science and Technology Planning," *Journal of Inter-American Studies and World Affairs* (Mar. 1980); Fernando del Rio and Salvador Malo, "Mexico," in Daniel S. Greenberg, ed., *Science and Government Report—International Almanac, 1978–1979* (Washington, D.C., 1979); and Babatunde D. Thomas and Miguel S. Wionczek, eds., *Integration of Science and Technology with Development* (New York, Oxford, Toronto: Pergamon Press, 1979).
5. There is not even one fairly competent history of the development of science and technology in Mexico. Apart from this, James believes that in Mexico the process of the "socialization" of science and technology is far from over.
6. Miguel S. Wionczek, "El subdesarrollo científico y tecnológico: sus consecuencias," in M. S. Wionczek, coordinator, *La sociedad mexicana: presente y futuro*, Lecturas 8, expanded 2d ed. (México: Fondo de Cultura Económica, 1974).
7. Manuel Gollás, "La planificación de la ciencia y la tecnología: el programa de acción de México," Symposium on Science and Technology in Development Planning, Mexico, 28 May–1 June 1979, WP/18 (mimeographed). The author speaks with dis-

- dain about "eager planning [that] apart from being pretentious never counted with solid theoretical bases in either economic theory or planning" (p. 2).
8. See a severe Marxist criticism of such abuse of dependency theories in Gabriel Palma, "Dependency: A Formal Theory of Underdevelopment or a Methodology for the Analysis of Concrete Situations of Underdevelopment?," *World Development* (Oxford) 6, no. 7/8 (July–Aug. 1978).
 9. See a statement made by the director general of CONACYT to the effect that "it is necessary to overcome the obstacles to development in the area of science and technology such as the absence of a policy for science and technology and of coordination" (*Excelsior*, 1 Dec. 1979).
 10. These activities are known through studies and documents published by CONACYT between 1973 and 1976 that include—without counting the three successive versions of the plan—some thirty volumes, all related to the problem of science and technology in Mexico and published in four series, *Estudios*, *Documentos*, *Directorios* and *Catálogos y repertorios bibliográficos*. In 1977 and 1978—perhaps for reasons related to austerity—CONACYT did not publish any study, analysis, document, or bibliographic information on the complex problems of fostering science and technology in the conditions of underdevelopment and dependency.
 11. Pointing out that the style of CONACYT's magazine "has a dangerous tendency to resemble that of *Reader's Digest*," a well-known member of the scientific community observed that he hoped that *Ciencia y Desarrollo* "would confront the problem of the relationship between the scientific community and the government and the public administration in general." See Cinna Lomnitz, "Ya va de nuevo: *Naturaleza y Ciencia y Desarrollo*," *Nexos* (Aug. 1978), p. 27.
 12. National Science and Technology Council, *Programa Nacional de Ciencia y Tecnología 1978–1982* (México, 2 octubre 1978; printed in March 1979). James, "Mexico," states that "the manner in which the projects were selected within the *Program* (leaving their selection to the bodies involved in the research, and classifying them according to nine broad categories) seems to be a method that was designed to affect the strong vested interests of the current structure of power and privilege within the scientific community as little as possible."
 13. United Nations Conference on Science and Technology for Development, Vienna, August 1979. *Monografía nacional presentada por México*, A/CONF. 81/NP.48, 10 May 1979.
 14. Public lecture by the director general of CONACYT at the series of conferences on the 45th anniversary of *El Trimestre Económico*, El Colegio de México, 25 July 1978.
 15. *Ley del Consejo Nacional de Ciencia y Tecnología y Exposición de Motivos*, Artículo 1.
 16. This lack of balance between CONACYT's political clout and its financial power has also been pointed out by foreign observers. See, for example, Diana Crane, *An Inter-Organisational Approach to the Development of Indigenous Technological Capabilities: Some Reflections on the Literature*, OECD Development Center, Industry and Technology, Occasional Paper No. 3 (Paris, Dec. 1974); and Eduardo Amadeo, "Los consejos nacionales de ciencia y tecnología en América Latina: éxitos y fracasos del primer decenio," *Comercio Exterior* (México) 28, no. 12 (Dec. 1978).
 17. It is fitting to reproduce here, in its totality, the only reference to the *National Plan* in the *Program*, which appeared more than two years after the plan:

At the end of the past administration, CONACYT published the *National Indicative Plan for Science and Technology* (375 pp.), a report that analyzed the current theories on technological development in third world countries, discussed the problems of technological dependence and offered a detailed analysis of the difficulties and advances in the development of Mexico's scientific and technological system. The latter included both a global analysis and breakdown by sectors of productive activity and by available resources. It also analyzed the different options that would permit the implementation of the theoretical model of technological development and recommended the programming of concrete activities. (P. 21)

18. In the initial phase of its planning tasks (towards the end of 1974), CONACYT organized a seminar on science and technology policy in which those responsible for such policy (or participants in its formation and implementation) in Argentina, Spain, India, Israel, Japan, France, and New Zealand participated.
19. See "Bases para la formulación de una política científica y tecnológica en México," Report to the Director General of CONACYT, Mexico, 8 Jan. 1974 (mimeographed).
20. The nonintervention pact existed from the day of the agency's birth due to the fact, among other things, that CONACYT's first director general was simultaneously a minister. Another of the ministers, and the president of the board of directors of CONACYT at that time, said in September 1972, to the author of this essay: "The CONACYT is not my business. While it does not interfere in my activities, I will not interfere with its work."
21. CONACYT, *Plan Nacional Indicativo de Ciencia y Tecnología* (1976), p. xii.
22. The formality of the national commission's support at the ministerial level derived from the fact that in the case of the plan for science and technology—like that of many others that were considered by the president's "collaborators" to be of secondary political importance—the secretaries of state had delegated their representation in the commission to intermediate level officials whose presence at the national commission's meetings were somewhat symbolic. Their objective was primarily to demonstrate the interest that different segments of the federal government had in a policy exercise that, although autonomous, was known to have strong direct support from the president of Mexico.
23. This discovery had political implication at times, since it was demonstrated, for example, that to a large extent so-called "research units" of the public sector were dedicated to compiling all sorts of second- and third-hand data and did not have any relationship at all to scientific or technological research.
24. According to the calculations of a professor of the National Polytechnic Institute, the internal cost of publishing a work in a well-known international journal was about three million pesos—ten times more than in the United States or Israel. This was the result of a lack of training on the part of a large number of the participants in science and technology activities whose productivity was close to zero.
25. Pérez Tamayo, "La investigación biomédica," p. 11.
26. The situation has not changed much with two events that followed the change of government: the administrative reform and the transformation of the ministry of the presidency into the ministry of programming and budget. While certain new administrative procedures were introduced, formal accounting concepts still prevail in the allocation of financial resources and no indication of an awareness of the importance of science and technology for the country's development can be detected in the budgetary process.
27. *Plan Nacional*, pp. 26 and 28.
28. The National Plan estimated that it was absolutely necessary for public spending on science and technology to increase by twenty percent annually in real terms. With the present inflationary conditions, such a rate of increase would be equal to forty percent annually in monetary terms.
29. "Consideraciones que hacen las instituciones de investigación científica y tecnológica acerca de los criterios necesarios para la asignación de los presupuestos de 1977," México, 18 octubre 1976 (mimeographed memorandum to the secretary of the treasury).
30. In 1979, a high-level CONACYT official explained that earlier preoccupation with the planning of science and technology was the result of "technological trauma" and that planning was not necessary since there were no "solid theoretical bases, even in the economic theory of planning," (Gollás, "La planificación").
31. Apparently the same tactic was used a few months later by another group of intellectuals that visited the president to ask that he draw up a national food program. None of the five members of the group mentioned that he had participated in such a program in 1976 under the auspices of the secretary of the presidency and the CONACYT.

32. Eduardo Amadeo, "National Science and Technology Councils in Latin America: Achievements and Failures of the First Ten Years," in Thomas B. Babatunde and Miguel S. Wionczek, *Towards the Integration of Science and Technology with Development* (New York, London, Oxford: Pergamon Press, 1979).
33. For a serious look at this topic, see, among others, "Dinámica de la ciencia, la tecnología y el desarrollo," Statement by the U.N. Symposium on Science and Technology in the Planning of Development, (Mexico, 28 May–1 June 1979).
34. James, "Mexico," p. 187.