

En diciembre se llevó a cabo en el Instituto Tecnológico de California, la cuarta serie de conferencias de 1970 sobre el tema

"THE ROLE OF SCIENCE AND TECHNOLOGY IN ECONOMIC DEVELOPMENT".

El Dr. Alberto Sandoval fue invitado a participar en esta serie, con un trabajo sobre "Los problemas del desarrollo científico en México". Dada la actualidad que este tema tiene en nuestro país, se solicitó permiso de publicación al Dr. Harrison Brown, organizador de este evento. Gracias a ello, se reproduce en su totalidad la conferencia presentada el 2 de diciembre de 1970.

Bol. Inst. Quím. Univ. Nacl. Autón. Méx., 22, 221-240 (1970).

## THE PROBLEMS OF SCIENTIFIC DEVELOPMENT IN MEXICO

I would like to start, by expressing my gratitude to my very good friend, Professor Carl Djerassi, who suggested my name as participant of this meeting, and to Professor Harrison Brown for his kind and formal invitation that has brought me, after 24 years, back to a fine Institute where I began my research training. This visit has enabled me to see a dear friend: my professor, with whom I spent over two years, at a time when chromatography was just a method seldom seen and rarely used, Professor Laszlo Zechmeister. To him I express now my gratitude, acknowledging the fact that what I have achieved was due to his teaching. It is also 24 years since I have been in Pasadena, to look at the new buildings and laboratories of Caltech, to look at the San Gabriel mountains, where I spent many a Sunday, in long forgotten times.

Recently it has become fashionable to talk about research: pure research, applied research, technology; what a rich country as the United States can do when the official support is withdrawn; what a poor underdeveloped country should do, to increase her income, the welfare of the people, the productivity index, the industrial development. What a semideveloped country as Mexico, can do to further her scientific achievement and economic emancipation.

Let me tell you that, although from a single corner of the Country —the University— I have seen everything that has happened in the last 30 years: I became a member of the Instituto de Química when just inaugurated in 1941. But for the two years I spent at Caltech, I have remained always there: that is, my whole professional life. Since 1953, when I became the second Director of the Instituto, I have attended all the meetings of the University Council, where the University laws are promulgated, and I have belonged, also, to the Science Council, where the scientific development of the University is judged and evaluated. The desperation I felt over 12 years ago, that the Country was being left behind in scientific development, lead me to propose the foundation of a scientific body, which materialized under the name of the Academia de la Investigación Científica —Academy of Scientific Research— of which I was the first President. In recent times —1968— I was nominated Vocal Químico —anyway, member of the board— of and official Government Agency, the Instituto Nacional de la Investigación Científica —National Institute of Scientific Research— where I have witnessed the efforts the Government is doing to increase our research potentialities.

Therefore, I think I am the only Director in the University that has witnessed, and generally opposed, the policies endorsed by three different Rectors —Deans— of the University: Dr. Nabor Carrillo's from 1953 to 1961; Dr. Ignacio Chávez's from 1961 to 1965 and Ing. Javier Barros Sierra's, from 1965 to 1970. Now, since May, we have had a new Dean, Dr. Pablo González Casanova.

As I said before, in recent times many countries have looked upon their potentiality in regard of researchmen, scientific research and the adequate policies to improve them. Curiously enough, it was precisely the USA who first wondered if they were doing right, when they received the shock of their lives: the first Russian atomic explosion. Later on, when the race to the moon took place, with the tremendous show of researchmanship that enabled the Americans to put first one man and then two on our satellite. But when making these appraisals, the Americans and the Russians were talking about hundreds of thousands of researchmen in their respective countries.

México and her scientists began to wonder about her research capacity some years ago. The first effort was done by the Academia de la Investigación Científica, to evaluate how many researchers were there and what were their standards. Later on, under the auspices of the Instituto Nacional de la Investigación Científica, the Institute of Social Research of the UNAM, under the direction of our actual Dean, Dr. Pablo González Casanova, a more thorough survey was done to determine the number of researchers and of research places. This effort, with the name "Las Instituciones de Investigación Científica en México" was published by the University in 1970. As a result of the same inquest, in 1969 another booklet was published: *Investigaciones Mexicanas en Proceso 1968-1969*. In it, the names of the research problems being in process were given. Finally, by Presidential decree, during this year a more masive effort was caried out. The findings, from which I will quote later on, gave birth to a volume of conclusions, which has valuable information, and that is supported by four more volumes of the proceedings, laws, bylaws, etc., which deal with scientific research.

Valuable as it is, from my point of view it has a major drawback: it is extremely overoptimistic. It says that there are 3,600 researchers. I believe that, at most, we have in México 1/10th of this amount. What was the reason to obtain such a large figure? Simply that in their canvassing they went asking "Do you carry out scientific research?" If answered positively, then they asked "How many researchers work here, how many full time and how many part time?" And what they answered was considered as facts.

My point of view is that, first of all, one should define what fundamental or pure research is. For instance "Scientific research is that work, carried out under the direction of somebody with a high academic degree, that pursuits the elucidation of unknown facts, unknown theories or the confirmation of such, which up to date, have not been clearly defined. Such results become scientific research, when they are let known to the scientific community, through the publication in an accredited journal". Such a definition would lead, immediately, to that of "who is a researchman" and

“which place is a research center”, which I would venture to express in these two following definitions: “A pure researchman is somebody that has got a high scientific training, preferably giving rise to an academic degree; one who devotes most of his efforts in pursuing goals, which lead to the enlargement of the knowledge of science, and whose contributions can be measured by the number and quality of scientific papers, published in good scientific journals. To be considered a researchman, this person has to have a productivity of (3, 5, 10, etc.) scientific papers in the last (3, 5, 10... years)”. And of a scientific institution, as “a place which, under the direction of (one, two, three, etc.) people with high academic standards, with the help of people with lesser training, has produced in the last (3, 5, 10 years) (3, 5, 10, etc.) papers published in high class scientific journals.”

Likewise, in the case of the “applied researchmen” the basis for judgement would be either the number of papers or of patents obtained and, in the same way the places of applied research.

From the three inquests, widely varying data is obtained: While the latest INIC report says there are 3 600 researchmen (in another part of the text, the figure is 4200), the book published by the University says there are only 1 212 (page 85) between the ages of 20 and 74, both male and female. This is 3 or 4 times less than in the first one. But it is worse still, if one considers the membership of the Academia de la Investigación Científica: its by-laws state that, in order to be a member, an application, endorsed by two members should be sent, together with the *curriculum vitae*. The latter has to show that the candidate has produced, at least, one paper in the last three years. Great efforts have been carried out in order to recruit all the researchmen in México, regardless of sex, religion or nationality. After ten or more years of existence, the number of members of the Academia is 182. That is about 20 times less than the first figure of 3600.

I have been examining these data with care, because the conclusions may widely differ between the first case and the third. But before dealing with them, I would like to continue using the analysis of the INIC report.

In chapter III, Recommendations, the following points are stated:

To increase the salaries of the researchmen, in order to induce more people to devote themselves into these activities.

I might explain what the situation is: at the University the highest researchman, after 20 or 30 years of productive work, will earn about 10 000 pesos a month (800 dollars). In addition, he might earn 1 000 more for teaching, and if he has got an administrative work—such as Director, as myself—about 6 000, giving a total of 16 750 before taxes (about 4 000). It means a total liquid earning of 12 750 (about 1 000 dollars a month) for a full time job. Outside the University, a similarly qualified person might earn three or four times more. What is the neat result? That very few persons see a future in the research field, and only those with a strong vocation, or those that are not able to find jobs in other fields, remain in research institutions.

Later on, in the INIC report, when they take for granted there are 3 600 researchmen, they set a goal of preparing 5 635 new ones in all fields in a six years' period. How?

I am sorry to disagree with this possibility, which I consider as wishfull thinking. As a direct experience, in the Institute of Chemistry under my direction for almost 18 years, we have given all possible opportunities to all the young people that have applied for a fellowship: in the 30 years of existence of the Instituto, over 330 students have come through. What is the result? That we are understaffed. Certainly we have provided with researchmen with all kinds of trainings to many Mexican institutions, but anyway, we should have now about twice as many full time senior researchmen.

Later on they express another ideal:

- It would be good, to initiate, under solid basis, a process of substituting the foreign technology for national technology... How? If what we lack is all kinds of researchmen?

Under the heading "Teaching and Research" it states enormously important points which I would like to state in a row, before commenting on them:

- All the people involved in the inquest agreed on the necessity of a general and integral reform in teaching, from the grammar school up to the highest levels of teaching, that would allow a better teaching of children, youths and adults and to relate them in a closer way to the national problems.
- Our educational system should indoctrinate in the students the ideal of working for the progress and development of the society in which we live, making them conscious as early as the grammar school, of the national problems, making them aware of them and stimulating their imagination, to propitiate their liking to dip into the knowledge of such problematics, and to help them when they develop an interest for some special subject in this field.
- The knowledge of the grammar school teachers should be brought up to date through the use of permanent short courses, seminars, publications and some other media.

Now, what is the real situation of teaching? At present, most of it is directed towards higher education. Is it possible to produce, exclusively, university graduates? But it is easier to pass the ball from one level to the next, hoping that, at later stages, things will become better. Grammar school is compulsory in México. Starting at the age of 6 or 7 years, the students go through 6 years of teaching. They learn how to read, write, some arithmetic, history, geography, etc. So they come out at an age of 12 or 13. What can they do? The output at this stage from 41 534\* primary schools in the country, was 675 878 students in 1968. Naturally, many of them have dropped out, for whatever reasons one might think of, and they will work in the lowest kind of jobs: bricklayers, maids, laborers, etc. But if they wish to continue, there are two alternatives opened for them: to enter the secondary school (three years) which predominate in the country (there are 2 026) which house 600 00 students. Up to recent times there was another type of second education: what was called the pre-vocational schools, for students who wanted to receive technical teaching. These were re-

\* See appendix.

cently converted into secondary schools. In 1968 there were 26 such schools with 20 286 students. There are, also, and in a very limited number, agricultural schools and other types of trainings. But one can consider that the mass of the students has gone through this second type of training. There they learn the language, history, mathematics, geography, etc., as a repetition of what they learned in primary school, but, obviously, in a more thorough way. But when these students come out, they do not know any trade whatsoever, although there are some ridiculous subjects in the curriculum: binding books, or electricity (where at most the students build a hot plate and a bell ring), carpentry, where they might build a stool or a table, or cooking. Can they earn their living with this knowledge? No.

If they are not too pressed because of economic reasons, they will continue studying and, therefore, they will seek admission into a higher learning step in any of the 328 preparatory schools of the Country. There are, besides, 50 vocational schools, which were, before, a second step of the prevocational schools. There they learn to work with lathes, welding, milling, etc., and when they come out they are qualified workers. But in the Preparatory school (3 years) they learn in the first two years some common topics: language, history, geography, ethics, etc. and specialized subjects when they get to the third year of studies. When they come out, at an age that varies between 18 to 19 years old, they do not know any trade from which they could earn a living. Therefore, either they drop out and become white collared workers, or, what is easier, they keep pursuing higher learnings, in any of the 106 institutions that give place to 200 000 students. How many of them come out with a degree? The short time I have had to prepare this lecture, going through all the official records, etc., have not allowed me to seek this information.\* But one can gather that out of the 200 000 students — which are distributed in all levels of a cycle of 5 to 6 years, one tenth go through the cycle: 20 000. Out of them, maybe 50% obtain their degree: 10 000. So, one could compare the educational system we have in México, to one of those fireworks that is a circle that rapidly rotates about its center, throwing

\* See Appendix.

beautiful and meaningless sparks everywhere: when it is over, most of the mass has burned out, and what is left, in most cases, is charred.\*

This black panorama is viewed from the optimistic side: taking into consideration, exclusively the statistics. But let us consider the *efficiency*. And then, the results are appalling: most of the primary schools are extremely inadequate; the secondary schools lack laboratories or good training. The preparatory schools, with a very few exceptions, are pretty bad and most of the high places of learning are very low places of learning.

Back at the beginning of this century, —when very few people studied— it was fashionable to send the kids abroad, preferably to France. Then came the revolution; education became compulsory and for several decades it was normal for everybody to study at the Government schools— primary, secondary and preparatory. Although there were a few private schools at that time, they were attended, mostly, by students whose parents were seeking a high class society, or when they had strong religious reasons, although, officially, since the time the Constitution was promulgated, it was forbidden to teach religion at the schools. Now, things have changed: the tremendous student explosion that has happened the world over, has let itself be felt in México. Everyday new schools are built, but never giving time to prepare good teachers to attend them; the overpopulation has made it a need to overcram each school with twice, three times or more with students in respect to what it was before. The results are catastrophic: now the parents who are interested in having their children receive a good education, have to resort to private schools, and in general, they are as bad as the public ones, because they have an economic motivation, and therefore, strong compulsion to save as much as possible, even if the saving affects the teaching standards.

This point of view —horrible— takes now the second negative aspect concerning education. Let us look at a third one: politics. While in general, primary and secondary schools are not directly affected by politics, things change when getting at the preparatory and higher learning schools, or Universities. Let us start with

\* See appendix.



the Preparatory school and let me tell you what I have witnessed as Director: Back at the time I studied, when one came out of secondary school, to enter Preparatory, one had to choose the field one was planning to study. The Preparatory school involved, only, two years. At the time when Dr. Carrillo was Rector, a modification was done to the Preparatory school: it was alleged that the students that were ment to come to the science area would have a lot of time to specialize, while they lacked, instead "humanities". Therefore a proyect was approved by an overwhelming majority of the votes at the University Council, and the "Bachillerato Unico" was established. It lasted 4 or 5 years with catastrophic effects: the students that attended the scientific area, lacked all kinds of scientific background, which resulted in the lowering of standards of the University Schools. Then a new Rector came: Dr. Ignacio Chávez. He was dead set against the Bachillerato Unico, and he proposed a change, where two years of Preparatory school were the same to everybody, while in the third (which was added) the specialized subjects were imparted. The project was accepted by and overwhelming majority of the members of the university Council. But at the same time, the number of subjects and the "hours of classes a week" were drastically cut, because the students shouldn't be subjected to the martyrdom of having to study full time. The students were left idle all afternoons, without homeworks to do, and this produced a further lowering of the standards. Up came the third Rector and he proposed to cancel the decimal way of grading the achievements of the students (from 0 to 10) and to put, instead three approving grades and a "not credited" mark to those who failed. The reason was to take away the psychological negative factor, for the low quality students, of having flunking notes in their files. These changes were accepted by and overwhelming majority of the members of the University Council and allowed all the students to present examinations, as many times they wished, of as many subjects they might have failed upon. This, in turn, made the teachers skip several lectures a week, because they had to examine such students all year long. The result? a further lowering of the standards. The new Dean has not instituted any new changes, yet. But in a meeting that took place on Nov.

19, he expressed his opinion that the graduate students, should all teach at the professional schools; the undergraduate students, should teach at the preparatory level; the preparatory students should teach at the secondary level and the secondary students should teach at the elementary schools. Many years ago, talking with Professor Djerassi about similar situations, he exclaimed: "the blind leading the blind".

Back in 1959, when I was inaugurated as President of the Academia de la Investigación Científica, I expressed the following idea: if in any academic year of each school, wherever it stood, and of whatever level, the authorities began to select the brightest students and put them under the most responsible and prepared teachers, and if this was kept year by year, a tremendous wealth of talents could be gathered, almost from the start. This didn't mean that the rest of the students should be kicked out of whatever they were studying.

Nothing came out of it.

Then, in 1960, again through the advise of Prof. Djerassi, I got a grant from The Rockefeller Foundation which allowed me to travel all over the world, visiting Universities in Europe, Israel, India and Japan. Everywhere I found that the University students were carefully picked out, through tests, from the mass of students of primary schools when they were 10 or 12 years old. The rest were driven towards other goals. I came back and expressed the idea that it could be carried out in México in the same way. The Science Coordinator at that time, answered me: "Dr. Sandoval, your trip all over the world was useless for you: México is completely different from any other nation; we need many mediocre professionals, not well prepared ones".

Then, there are the "politics" in those institutions that depend, directly, from the people in the Federal Government or in the States Governments; the work of the researchmen in such offices will depend, mainly, on the whims of these authorities in charge. Since they are generally jealous, they will never accept what was done before their times, but they will wipe out whatever they found standing when taking office, brush it aside and start completely new

projects. This produces a zigzagging effect and a waste of an enormous amount of efforts, equipment, personnel, etc.

Unbelievably enough, there are still more negative factors: the language barriers. One finds so often that students that are already candidates to a D. Sc. cannot speak any foreign language, so it is impossible to think of sending them abroad for a further training. And this is in spite of the fact that at the primary and secondary levels, English is compulsory. And of course this fact has also a tremendous importance when a solution of importing teachers, professors, researchers, etc., is suggested.

When the University City was built, there were 30 000 students as an overall population of the University. It was built for a population of 40 000. The people thought it was a "white elephant, that never was going to be used". Sixteen years later, the overall population is over 100 000 students, 15 000 teachers and about the same number of administrative personnel. The authorities talk about letting it grow, or even duplicate itself. I do not like this solution. I think the University should fix the maximum enrollment; were there more applications, they should select the best students, while letting the responsibility of creating new universities or technical schools to the Federal or Statal authorities. These new institutions should be completely separated from the University.

If the teaching and learning have suffered such serious drawbacks, it is obvious there has never been time to prepare teachers, which have to be improvised from the amorphous mass of students, that reach the last years of study. Worse still are the rest of the "high learning" institutions, because they lack funds. Therefore, the probability of forming researchers is almost null.

Nevertheless, in the very first page of the INIC report, it says: "In former times there was a lack of a critical mass of researchers and technologists, which now are available..."

In the same report, one can get the following data:

#### RESEARCHMENT FOR EVERY 10 000 INHABITANTS

Russia	60
U.S.A.	50

Holland	40
Germany	36
Belgium	22
Italy	10
Spain	4
Greece	3.2
México	0.75

This figure, of 0.75 is obtained from the overoptimistic data that there are 3 600 researchmen. If they are 182, as the Academia de la Investigación Científica shows in relation with its members, the figure for México comes down to 0.038. Is it possible to consider such a figure enough for a "critical mass"?

In spite of these facts, now that the importance of scientific research has reached the government heads, they want to pile up so many objectives upon it, that it could be figured as follows: Imagine a town where the whole population is starving. They are told that a special seed would be so nutritious that, if in enough quantities, the town would be saved: everybody goes frantically looking for the magic plant. In a faraway place some find a few tender seedlings, yellow looking, but some of them are showing the signs of blooming or even of producing a few malformed seeds. Everybody yells with happiness and they proceed to bring whole carloads of manure to pile on top of the seedlings hoping that just by this simple act they will become vigorous and solve the starvation. At the same time they grab the few seeds and divide them between the whole population. What would be the result? That nothing is saved: the seeds are insignificant for so many people; the seedlings cannot grow at a rate of 10 or 100 times of the usual rate; and the manure is wasted.

The aims the INIC report has stated for the next year is quite large. Allow me to take a few examples, as appear in page 130 and subsequents:

To improve the agricultural, cattle, forest and fishing productions.

To push industrialization and productivity efficiency.

- To substitute the needs to import goods and technology.
- To improve the exportation of goods.
- To prepare a qualified body of workers at all levels.
- To look for a more adequate feeding, better education, better housing and social services.
- To better the environment, the drinking water, the electric energy, the system of communications.

And the list grows and grows. This report throws the whole telephone book at the poor seedlings of research existing in México. Now let's look at some economic aspects of México, wether with the help of scientific research or not:

Agriculture. México es supposed to be agricultural country.

Out of the cultivated 15 000 000 *hectáreas*,\* only 3 000 000 are irrigated. They produce high yielding crops. But from the other 12 000 000, depending on the clemency of the heavens, very often poor yields are obtained.

Over 45% of the population lives from agriculture. Most of them are starving, and often we are not provided with enough products to satisfy our internal consumption.

In comparison, the data I have is that 10% of the US population are farmers: not only they feed the whole country, but there is enough to export or to horde for future uses —either when famines happen in faraway countries, or when a screw has to be tighten, by a dumping that makes all the prices crash.

The high quality harvests, that depend mainly on exportation to the US, are threatened yearly by sudden withdrawals of importation permits which cause whole crops to rot in the fields, with the corresponding losses of foreign currency.

At one time México became a major producer of steroids for hormone syntheses. These were obtained from a wild root that grew in the tropical jungles of México. It is now near extinction, as Prof. Djerassi might corroborate us.

\* One hectárea is a square of  $100 \times 100$  m.

Vast areas of woods have been chopped down, to use them as timber or worse, to manufacture charcoal. Nothing has been planted in their place, causing an ever growing percentage of land subjected to erosion.

Whole plantations of bananas are contaminated with fillarias.

Our cacao, lemon oil and other products fetch the lowest prices in the international markets, due to their low quality or unreliability. At one time there were large woods of linalool trees: they have been cut down to extract from them, in the most inefficient way, the essential oil.

On the other hand, we are hailed as saviours of the world famine, due to the research the Rockefeller Foundation did during the last 30 years, and these mutants are sold —or given away— to countries as India and Pakistan, where bumper crops are harvested. We are not able to extensively use them in México because we do not have enough irrigated land.

Mining. México was enormously rich at the time the Spaniards came: the amounts of gold and silver mined were unbelievable; since then the mines have been depleted: we produce silver and gold; tin and lead, iron, copper and a few other minerals. In general, the prices are so low that miners live in the fringe of bankruptcy, with the everpresent fear of a dumping or of a lowering of the international prices or the erection of importation barriers.

We lack enough refining plants where the metals could be processed: generally the concentrates are sent to the US or even to Japan, although there are a few refining plants which were, up to very recent times, foreign concerns.

Energy. México has prospected enough hydrocarbons for consumption in the next 20 years. But this supply might not last that long. The hydrocarbons are used as a combustible to produce 89% of the energy; 4% is obtained from carbon and 7% from hydroelectric energy. What will happen when we run out of oil?

Industry. The great majority belong to foreign concerns, which only add the words "de México": General Motors de México; Celanese Mexicana; Cyanamid de México; Esso Mexicana, etc. etc. None or mostly none of these companies carry out any research in México, adducing that it is not necessary to repeat what has

already been done elsewhere. Therefore, they don't even need highly trained personnel. This fact reflects itself in the Universities: the lack of pressure from industry to get highly trained graduates, lowers the standard of teaching and the need to form research centers where such personnel could be trained. In the field of chemistry, the Instituto de Química as an academic research center, and Syntex Laboratories as an industrial research institution stand almost alone in México.

Coming back to the INIC report, it suggests as one of the remedies the institution of fellowships at all levels. I fully agree, but great care should be taken in order to insure that, when the student comes back home, he has a place waiting for him. At the present time, fellowships are given haphazardly, by many institutions and without any interknowledge, giving rise to the malady of the "eternal fellowship holder": some of them have it so good, with two, three or more fellowships at the same time, that they can live as tycoons in foreign countries, without any responsibility; therefore they resist giving back such privileges and coming back to the country to sweat in order to earn their bread. On the other hand, there are often enough the cases of students that have done a good job abroad and, when coming back they find there is no opening for them or that the field of their studies is not cultivated in any Mexican institution. These persons become as forgotten satellites, perambulating through the empty space.

The INIC's budget for 1970 was 9 011 000 pesos (about 720 thousand dollars). From this amount, over 5 million pesos (about 56%) has been spent on fellowships for graduate students, to allow them to get a Master or a Doctor's degree, either in México or abroad. Very seldom fellowships are refused or cancelled before the students attain their goals. Nevertheless, at this late time of the year, we have over 600 000 pesos meant for fellowships unspent. Once the student has obtained his goal, the INIC washes its hands and the student is on his own to look for a suitable allocation.

The most important goals set up by the INIC for the lapse 1971-1976 are the following:

- The creation of a highly placed governmental agency in char-

ge of the formulation of the indicative programs of the pure and applied research, as well as the distribution of the attained results; to procure the participation of the scientific community in the formulation of the programs. The proposed name for such an agency, would be the "Scientific and Technological National Council".

- The allocation, for the first year of activities of this council, of 22.9 million pesos.
- To reach a goal of expenditures in scientific and technological research, in 1976, of 2 364 millions, instead of what is being spent now (519 millions).
- The needs for the lapse 1971-1976, will be of 8 512 million pesos, of which 48% will be spent in salaries, 44% in expenditures and 6.5% in fellowships.
- To produce researchers at a growing yearly rate of 16.8%.

From my humble point of view, the program should be:

- a) The selection of students and teachers at all levels of education. The rest of the student population *would not be disturbed*. This selection should be very flexible, allowing bright students to be incorporated into the selected groups or viceversa.
- b) As soon as possible, new teaching programs should be established for the mentally privileged students, together with better paying incentives to the good teachers.
- c) To establish fellowships along all the educational levels. In the grammar and secondary schools, these fellowships would be given, as grants, to the parents, to draw their attention towards their promising children. When the students reached the Preparatory school or higher levels, the fellowships should be given to them, as a reward for their efforts. It would continue higher up, to the master degree or to the doctorate.
- d) To put a tremendous emphasis in the teaching (and learning) of a foreign language (preferably English).
- e) To carry out an inventory of all the expensive equipment that has been imported to México and to gather the pertinent



information concerning 1) if it is in working conditions; 2) if it is being used, and how efficiently; 3) when some research center would require such an expensive equipment, to look at the files and, if pertinently, to reallocate the equipment.

- f) To carefully control all the fellowships and to follow the improvements of the students. The fellowships should be increased in relation to the achievements of the students.
- g) To prepare for the returning students working positions where their knowledge would be utilized to the maximum advantage. The salaries they would earn at the new positions should never be lower than what they were earning as fellowship holders.
- h) To procure a yearly increase of the budgets of the research centers, in accordance with the productivity shown as obtained results.
- i) To propitiate the creation of many research centers of approximately the same level of knowledge, and to procure the interchange of personnel for short, medium or long periods of time to promote a higher academic environment.
- j) To supply the researchers with adequate salaries, that would free them from worries that take their minds off their scientific studies. A high social program should be started, providing them with homes, cars and other luxuries in relation to their achievements.
- k) To try to gather good libraries, attached to the bigger or more efficient centers of research, and from where service would be given to all the other institutions, eliminating, in this way, duplicate and expensive efforts. Naturally, each center would have the most common literature in their files.

I think these programs could be put into effect smoothly and rapidly, without heavy expenditures, but with yearly increases for budgets. That is, no Fausts should be needed, to sell their souls to the Devil ... or to the OEA... or the Ford Foundation.

## APPENDIX

\* Once this paper had been typed, I received the following statistics that I consider reliable. Due to their interest, they are included as an appendix:

### NUMBER OF STUDENTS ENROLLED IN HIGH LEARNING (UNIVERSITY LEVEL)

<i>Grade</i>	<i>1963</i>	<i>1964</i>	<i>1965</i>
First	38 534	38 840	56 954
Second	27 555	27 594	39 200
Third	18 475	20 889	34 445
Fourth	14 023	16 314	27 282
Fifth	9 592	10 466	16 721
Sixth*	2 199	2 525	2 829
Totals	110 378	116 628	177 431

### FIRST STAGE OF EDUCATION (PRIMARY SCHOOLS)

1968

Number of urban grammar schools	10 503
Number of rural grammar schools	31 040
<b>T O T A L</b>	<b>41 543</b>

\* There are very few professional careers that require 6 years of training.

Number of Teachers of grammar schools 180 431  
 Number of students

1st year	2 229 708
2nd year	1 619 354
3rd year	1 340 596
4th year	1 046 634
5th year	830 027
6th year	675 878

---

T O T A L 7 812 197

### SECOND STAGE OF EDUCATION 1968

Number of secondary schools	2 026
Number of prevocational schools	26
Total number of students in secondary schools	600 558
Total number of students in prevocational school	20 386

### THIRD STAGE OF EDUCATION

Number of preparatory schools	328
Total number of students	114 986
Number of vocational schools	50
Total number of students	35 400
Total number of students	200 386

FOURTH STAGE OF EDUCATION  
(Professional)  
1968

Professional schools	294
Total number of students	143 345
Normal schools	269
Total number of students	56 436
Commercial schools	672
Total number of students	94 678
Special schools (art, etc.)	564
Total number of students	84 347
Total number of students at this stage	378 806

NUMBER OF STUDENTS ENROLLED IN 1968 IN ACCOR-  
DANCE WITH GENERAL SUBJECTS

	<i>First</i>	<i>Second</i>	<i>Third</i>	<i>Fourth</i>	<i>Fifth</i>	<i>Sixth</i>
Technical & Scientific	23 198	14 701	12 576	10 054	5 773	3 200
Medical	7 390	5 085	5 003	3 781	3 337	2 313
Humanistic & Pedagogic	7 459	4 755	4 256	3 323	553	484
Social & Political	5 628	4 761	4 402	3 649	2 824	*
Administrative Accounting Statistics	13 221	9 875	8 180	6 439	4 234	*
Artistic	58	23	28	36	**	

\* Only 5 years of curriculum.

\*\* Only 4 years of curriculum.