Research & development for the next thirty years

Part 29
Ibero-American integration

The capacity for sustained and autonomous development of Ibero-America depends on its being able to reach world stature in the domain of scientific and technological research. Nuclear energy is one crucial area in this regard, both for its immediate productive potential, and for the opportunities for training personnel that it presents.

This installment concludes Chapter 10 of *EIR*'s exclusive translation of the Schiller Institute book, *Ibero-American Integration: 100 Million New Jobs by the Year 2000!* published in Spanish in September 1986. It was commissioned from an international team of experts by the Schiller Institute's Ibero-American Trade Union Commission, to elaborate the 1982 proposal by Lyndon LaRouche for an "Operation Juárez" that will transform the huge foreign debt problem into the springboard for a regional economic boom—and an unheralded world recovery.

Numbering of the tables and figures follows that of the book.

The previous installment presented the first part of Chapter 10, dealing with the first phase of organization of R&D in Ibero-America, and nuclear energy.

New industrial technologies

Another priority for Ibero-America is the use of the most advanced technologies in the machine tool area. A commission must be created to survey and establish the precise kinds of machine tools that will be needed, as well as the most rapid way to manufacture and deploy them. It will perhaps be possible to skip certain stages of machine-tool technology and move directly to lasers and other advanced technologies. If feasible, the gains in productivity will be dramatic.

Metal-refining technologies will also be very important. The region contains a large share of the world's mineral resources, and further exploration will no doubt show further deposits. Yet the existing methods for refining most of these minerals are highly capital- and energy-intensive. A whole new range of metallurgical technologies is on the horizon, involving low-temperature plasmas, and Ibero-America must become a world leader in this field. A proper location for an Ibero-American Institute of Advanced Metallurgy would be Peru or Chile, given their importance in this field. Several processes are already operational in pilot projects, and Ibero-America should invite the developers of this technology to apply them in the region. As already mentioned, an offshoot of fusion technology is the fusion torch, which will operate at much higher temperatures, permitting refining by high-temperature plasmas.

A related materials-processing field is that of MHD (magnetohydrodynamics), as described in earlier chapters. Little has been done in this area in Ibero-America, but Colombia and Venezuela—given their plentiful deposits of coal and iron ore—would be good locations to set up an MHD Research Institute.

Agricultural, ecological, and hydraulic research

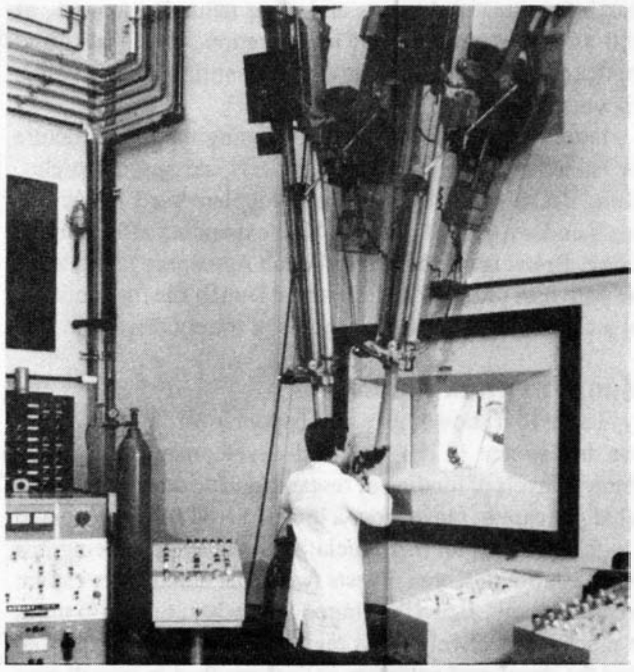
The possibilities of enhanced agricultural productivity with optical biophysics and biotechnology are almost limitless. Optical biophysics promises revolutions in genetic engineering and many other medical and agricultural applications. Not only can yields be raised several-fold, but new breakthroughs in biological pest control, improving the nutritional quality of many farm products will take place.

Given the importance of water-management in Ibero-America, another revolution in agriculture will depend on mastery of the field of hydrodynamics. Mexico would be an excellent location to establish a research institute to study these related fields, and should perhaps be named the Leonardo da Vinci Institute of Advanced Hydrodynamics, in honor of the great Italian scientist's pioneering work in the field of hydrodynamics.

Enhancing utilization of the seas will also be important. Ibero-America already extracts from the sea a considerable portion of the world's fish catch. Yet, very little is known about the dynamics of biomass in the oceans. The present yields of fish from the ocean are not large, and there is a great need for sustained research in the dynamics of marine biomass development. Peru is the Ibero-American leader in fishing, and would be the logical country for an Oceanograhic and Marine Biology Center, in close collaboration with Chile. Not only ocean mapping and study of the dynamics of fish populations, but possibilities for coastal and inland fish farming must be investigated as well.

Meteorology—weather and climate research—is also of the greatest import. Ibero-America is one of the most important determinants of the earth's weather and climate, the Amazon rain forest, and is very close to another, the Antarctic. Brazil and Argentina, respectively, must take the lead in scientific investigations of the dynamics of these weather-controlling systems, and should host a Meteorological Center.

The dynamics of the Amazon must be mastered before any further deforestation is permitted to take place. Major portions of the Amazon may eventually be capable of agricultural use, but before any more forest is cleared, broad pilot experiments must be conducted to determine what, if anything, can be safely done to develop the potentials of that region. As for Antarctica, Argentina has long maintained a research station there, and also has weather-monitoring stations in Tierra del Fuego. Unlocking the workings of this region will be important for better understanding world weather and climate patterns.



An Argentine technician handles radioactive cobalt-60 by means of a robot. Nuclear energy is a crucial area for training the scientific personnel Ibero-America needs.

Modern science has to resolve the major problem of earthquakes in Ibero-America. It is common for entire cities to collapse, as the "inevitable" result of earthquakes. An Institute of Seismic Studies must be founded, possibly in Mexico City. Given that the tectonic plates, which exert tremendous pressures against each other, create detectable paramagnetic fields, it is possible to work out methods for predicting tremors. Japanese scientists have done interesting work in this direction.

Aerospace and satellite program

Ibero-America must enter the space age. This entails, immediately, setting up the facilities to utilize existing satellites and become trained in all satellite-related technologies. Most countries should set up satellite monitoring stations to receive direct satellite transmissions, to image them, and to interpret and utilize the results. This is a means to acquire the technologies involved in satellite information, and also to move to the stage of designing and manufacturing satellites.

The use of satellites is critical for the telecommunications industry, which will be an increasingly important element of regional infrastructure. One important function in this regard will be its use in education, both for bringing courses from basic literacy to university level, to outlying areas within countries, and for linking university and research centers across the entire region. Remote sensing technologies will be important for agricultural and land use research, and in the search for mineral deposits and other natural resources, as well as in metereorological investigation. It will also find application in marine biology and identification of marine resources.

Equally important will be developing the infrastructure for launching the region's own rockets and space vehicles. Here, Brazil's existing program, supplemented by Argentina's endeavors, will be crucial to expanding efforts in the future. Brazil is the logical site for an Aerospace Institute, as the northeast of Brazil is the optimal launch site for continental rockets because of the closeness of the equator.

Manpower and funding

Table 10-1 shows the relativity poor level of Ibero-American investment in research and development today. The absolute levels of funding of research and development, measured per capita, range from a low of $1.64 for Colombia to a high of $15.66 for Venezuela, with the average being just over $10. South Korea invests twice that amount per capita; West Germany, Japan the United States 30, 26, and 35 times as much, respectively. This region is thus much further behind the developed countries in this area than in overall economic development.

The situation in terms of the absolute numbers of scientists in research and development is also very deficient. As an average, Ibero-America has about 250 scientists and engineers per one million of population, compared to the range of 2-4,000 for West Germany, Japan, and the United States. Since the funding levels are relatively lower in Ibero-America, this means that the expenditures per scientist and engineer in R&D are also lower than in the mentioned developed countries, (see column 6), by a factor of 2 or 3. This deficiency is particularly serious with respect to such areas as nuclear research, where the investments in proper equipment are extremely expensive, and is simply not being incurred in Ibero-America.

It should also be noted that, within Ibero-America, Argentina ironically expends the lowest amount per scientist, while Colombia has by far the smallest total expenditure for R&D and the smallest number of R&D scientists.

South Korea, which started from a position worse than Ibero-America, both in overall economic development and in its educational development, has now surpassed Ibero-America R&D investment. It spends over 1% of its GNP on R&D, and more than $20 per capita, has as many scientists in R&D as Brazil (which has more than three times the population of South Korea), and has more than three times the number of scientists and engineers in R&D per capita than the Ibero-American average. Moreover, South Korea has trained well over half a million scientists and engineers who are now productively employed in industry and government.

In setting goals for Ibero-America (see **Table 10-2**), we have chosen the rough target of attaining present OECD levels of per capita finding and numbers of personnel in R&D. This provides us with an order-of-magnitude estimation, although it will probably be the case that the expenditure

TABLE 10-1

Research and development, various countries 1980/82

	R&D expenses (millions of dollars)	% of GNP for R&D	Per capita R&D expenses (dollars)	Scientists and engineers in R&D	Scientists and engineers per million inhabitants	R&D expenses per scientist and engineer
Argentina	120	0.17	4.25	10,486	369	11,444
Brazil	1,704	0.60	13.44	32,508	256	52,418
Colombia	44	0.11	1.64	1,083	40	40,628
Chile	114	0.45	9.92	4,530	394	25,166
Mexico*	300	0.18	4.10	12,000	164	25,000
Peru	162	0.71	9.31	7,464	429	21,704
Venezuela	262	0.38	15.66	4,584	274	57,155
Ibero-America	3,745	0.49	10.34	90,936	251	41,183
South Korea	798	1.06	20.31	32,117	817	24,847
F.R.G.	19,051	2.48	309.26	128,162	2,081	148,648
Japan	31,219	2.61	263.67	531,612	4,490	58,725
U.S.	82,350	2.70	355.72	728,600	3,147	113,025

* Our own estimates

Sources: UNESCO, World Bank

TABLE 10-2

Research and development projections in Ibero-America 1985-2015

	1985	2000	2015
GNP (billions of dollars)	623	2,604	10,876
R&D expenditures (billions of dollars)	3	39	272
% of GNP dedicated to R&D	0.48	1.5	2.5
Total scientists and engineers	n.a.	1,250,000	5,500,000
Scientists and engineers in R&D	95,000	350,000	1,575,000
Scientists and engineers in R&D per million inhabitants	251	625	2,000
University graduates per year	5,000	2,200,000	3,900,000

per researcher will need to be higher, since the sophistication, and hence the expense, of more kinds of equipment increases with the advance of technology. Nonetheless, Table 10-2 usefully indicates the scale on which Ibero-America must expand its investment in this vital area.

It was projected that Ibero-America would expend by 2015, 2.5% of its GNP on research and development, approximately the level of West Germany, Japan, and the United States today. This will require spending 1.5% of GNP, or $39 billion, as early as 2000, which represents an 18.6% annual rate of increase between 1985 and 2000. This could slow to a 13.8% annual increase in the second 15 years, which would bring total expenditures to $272 billion.

If the number of scientists and engineers engaged in R&D grows at a conservative 9.8% per annum for the next 30 years, the region will achieve the per capita levels of West Germany today. It can be seen that this will mean having a pool of 350,000 R&D scientists and engineers by 2000, and 1.5 million by 2015, which is double the number in the United States today.

On this basis, it is possible to estimate that the total number of scientists and engineers in all areas of the Ibero-America economy must rise to the level of 1.25 million by 2000, and 5.5 million by 2015.

One invaluable resource that must be tapped inmediately, and which can accelerate the pace of the required R &D programs enormously, is the pool of Ibero-American scientists now living and working outside the region. Most have emigrated for lack of adequate facilities or employment in their native countries, or for political reasons. It is in this respect than the low level of expenditures for R&D per scientist (Table 10-1) has its most disastrous effect.

The quality of research is necessarily strongly affected by the newness or obsolescence of the laboratory and other equipment required. It is sadly the case that in Ibero-America, the vast majority of scientists, including those originally trained abroad, return home only to fall behind the most advanced foreign developments in their fields for lack of equipment and an encouraging research environment. By attracting back this pool of expatriate scientists and engineers by offering appropiate research facilities and environments, we can in a very short period upgrade the quality of research efforts several-fold. Brazil very successfully applied this approach several years ago when it successfully attracted back to Brazil a number of laser scientists to work on programs in Brazil, by properly funding its own laser effort. A catalogue of scientists and engineers abroad should immediately be compiled, and efforts gotten under way to draw them back.

Otherwise, to achieve these goals requires both an upgrading and expansion of existing college and university-level facilities for natural science training, and a great national effort to interest the students of each country to choose the disciplines, primarily in the natural sciences and mathematics, that are required for the research and development effort and for overall development. As the last line of Table 10-2 indicates, our educational goals mean that there will be over 2 million Ibero-America students graduating from universities every year by 2000, and almost 4 million by 2015, so there will be no shortage of candidates to be trained. But the funding for the laboratory facilities, the scholarships to keep students in school, and the qualified teachers, must come from national and regional sources, to guarantee that the goals of the program are met.

One example that indicates the ability of the region to achieve goals otherwise considered impossible, when national emergency demands it and sufficient national will exists to rise to the challenge, is the case of Pemex, the Mexican national oil company, starting with its nationalization in 1938. Mexico was nearly blockaded as a result of this act of sovereignty, but Pemex—and the country—went on to develop the oil industry to its current world stature.

This kind of effort, multiplied many-fold, can accomplish in the research and development area what today might seem impossible.