

The Search for a Scientific Community in Venezuela: From Isolation to Applied Research

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THE DEATH of the dictator, Juan Vicente Gómez, in 1935, brought to a close a period which some historians have described as the end of the nineteenth century in Venezuela. A prolonged and repressive dictatorship which ruled the country for 35 years—first the dictatorship of Cipriano Castro between 1899 and 1908, and then that of Juan Vicente Gómez from 1909 to his death in December 1935—left the scientific domain a desert with very few oases of activity. The Academia Nacional de Medicina and the Academia de Ciencias Físicas, Matemáticas y Naturales were almost entirely decorative and were of no scientific or social consequence. The Universidad Central de Venezuela, deeply demoralised by Gómez's rule and dragging out a spiritless academic existence which had hardly changed since the nineteenth century, became an object of contention for those who wished it to perform some of the intellectual and social functions of universities in other countries.¹ In the mid-1940s, small groups of teachers of a more intellectually serious outlook began to take up appointments in certain university faculties and schools, where they tried to create opportunities for the teaching and investigation of scientific and technological subjects.

In 1950, Venezuela was still a small, backward country; of its five million inhabitants, 51 per cent were illiterate. As far as science was concerned, it was very poor in the physical sciences. This was partly because Venezuela lived mainly from its oil revenue, just as, at an earlier stage, the country had lived from the benefits of its agricultural exports, coffee and cocoa; most manufactured products were imported. There was no local demand for, or application of, knowledge that natural scientists might produce, nor any economic incentive to support them. Universities had no science faculties; the main research activities were in medicine and agronomy. The only graduate programmes in the country were in medicine.²

Student enrolment in the three Venezuelan universities—the Universidad Central, the Universidad de los Andes and the Universidad del Zulia—as late as the academic session of 1952–53 was 4,390. As a result of the policy of violent repression followed by the military dictatorship which came into power in 1948, and which resulted in the exile, imprisonment and expulsion

¹ Tejera, E. "Exposición ante las Cámaras", *Memoria de Educación Nacional* (Caracas: 1939), pp. xiv–xv.

² On intellectual, scientific and cultural activities in Venezuela in the 1940s, see Vessuri, H. and Safar, M., "Elementos para el estudio social de la ciencia en Venezuela: la Sociedad Venezolana de Química", Díaz, E., Texera, Y. and Vessuri, H. (eds), *La ciencia periférica: Ciencia y sociedad en Venezuela* (Caracas: Monte Avila Editores, 1983), pp. 121–165.

of teachers and students and the temporary closure of the main university—the Universidad Central—the latter had 1,672 students in 1952, a smaller number than the second ranking university in importance—the Universidad de los Andes—which was located in the province of Mérida and had 1,908 students. The hostility of the government towards the state universities led, from 1953 onwards, to the creation of private universities; the first were the Universidad Católica Andrés Bello and the Universidad Santa María, both in Caracas.³

During Gómez's prolonged rule, those few students whose families were rich enough had their primary and secondary education in the central countries of Western Europe and North America; some thereafter lived alternately in Venezuela and Europe, with long periods in the latter—if they had scientific or cultural interests, they did not expect to find an environment congenial to those interests in their own country.

The life of Francisco José Duarte (1883–1972) who, with Juan Manuel Cajigal (1803–56), is considered the most distinguished Venezuelan mathematician, is a case in point. Born in the province, he studied at home until, in 1903, he became a student at the Universidad Central studying engineering; he graduated brilliantly in 1908. In 1911 he worked as auxiliary engineer of the Astronomical Commission and later became director of the Central Office of the Physical and Political Map of Venezuela. He alternated his scientific activities with teaching and political issues. Although he kept his links with Venezuela, he spent many of his most productive years in Europe, mainly in Switzerland. Among other activities, he worked from 1925 to 1935 with Viscount R. de Montessus de Vallores at the University of Paris, and with Professor Dimitri Midimanoff at the University of Geneva. After more than ten years in Switzerland, at the death of the dictator Gómez, he was called back by the government of López Contreras to become director of the Observatorio Cajigal; later he became president of the Colegio de Ingenieros and was twice president of the Academy of Physical, Mathematical, and Natural Sciences.⁴

Those Venezuelans who returned as university or secondary-school teachers, or as technicians of one of the oil companies, found little stimulus to continue research and were soon irretrievably lost to science. A deep cultural inertness prevailed in this provincial milieu. In the 1920s and 1930s only a few individuals—like Enrique Tejera, José Rafael Rísquez, Juan Iturbe, Carlos Ottolina, José Francisco Torrealba, Arnoldo Gabaldón and Humberto García Arocha—tried to do research on their own initiative, especially in the medical field. But according to the memories of a significant

³ Figures from the Ministerio de Educación, *Memoria y Cuenta 1953* (Caracas: Ministerio de Educación, 1954). On the situation of the universities, see Leal, I., *Historia de la U.C.V. 1721–1981* (Caracas: Ediciones del Rectorado de la UCV, 1981), pp. 323–326.

⁴ Roche, M., "Apuntes para una historia de la ciencia en Venezuela (desde su inicio hasta 1950)", Aguilera, M., Rodríguez Lemoine, V. and Yero, L. (eds), *La participación de la comunidad científica frente a las alternativas de desarrollo* (Caracas: AsoVAC, 1982), pp. 30–31.

witness—Francisco De Venanzi, one of the founders of modern Venezuelan science, born in 1917—these persons had only a very slight influence on the younger generation through their teaching.⁵

However, by the middle of the present century, the situation began to change. As one part of the international pattern of the unprecedented expansion of capitalism after the Second World War, Venezuela underwent marked changes.⁶ But the greatly increased social mobility was not solely an automatic effect of economic growth. It was also the result of a deliberate political decision by a liberal fraction of the social and political oligarchy, with the support of and in accordance with the expectations of the newly enlarged urban middle class. The growing revenues made available by the sale of oil provided the new civil service, which had been reconstituted after 1936, with the means of creating a service economy. This was made possible by policies of import substitutions, the expansion of capitalistic agriculture, and governmental provision for the support of the service occupations in health, housing and education. It thus became possible to improve the standard of living of large parts of the population; the small urban middle class which benefited from these policies took advantage of them to find a place in the civil service and to guide their offspring to it.

Education acquired great economic and social attractiveness—not least because it offered the opportunity for upward mobility. The situation was an aim of the government, both as an objective in its own right and as a means of carrying out its economic policies. The construction of school buildings throughout the country was taken in hand, the Instituto Pedagógico was founded for the training of secondary-school teachers—Chileans being appointed as professors—experimental primary schools were created and there was a considerable effort to increase enrolment in primary schools. Government policies which aimed at the industrialisation and the economic diversification of the country generated an apparently unlimited demand for scientists, technologists and managers who would aid the government to carry out its policy of modernisation.⁷ Education appeared to be the obvious and most direct means to achieve these objectives.

The most immediate sources for the qualified persons the country required for its industry, and for the training of skilled administrators and technologists, were the countries of Western Europe and North America. Between 1936 and 1946, despite official willingness to favour immigration, there was as a result of the war in Europe a migration balance of only 19,855 persons—an average of 1,805 per year. But from 1948 onwards the

⁵ Antillano, P. *Francisco de Venanzi* (Valle de Sartenejas: Asociación de Profesores de la Universidad Simón Bolívar, 1983), p. 26.

⁶ On contemporary Venezuelan society, see Maza Zavala, D. F., *et al.*, *Venezuela, crecimiento sin desarrollo* (Caracas: Universidad Central de Venezuela/Tiempo Contemporáneo, 1974).

⁷ Tovar, A. and Negretti, D., "Investigación educativa y planificación de la educación en Venezuela", in Vessuri, H. (ed.), *Ciencia académica en la Venezuela moderna. Historia reciente y perspectivas de las disciplinas científicas* (Caracas: Fondo Editorial Acta Científica, 1984).

"open-door" immigration policy established in 1936 began to show results. There was a marked flow of immigrants which continued until 1958, reaching a peak in the year of 1957 when immigration exceeded emigration by 46,056.⁸ The government were interested in not only agricultural labourers and colonists but also industrial workers, skilled craftsmen and professional engineers. Rómulo Betancourt, the democratic leader, defined the new immigration needs in these terms:

Emphasis was laid on the selection of farmers, but the country needed not only them. It also required physicians, laboratory workers, skilled labourers, craftsmen, etc. And against the myopic agrarian argument that only the foreigners who tilled the soil were useful, a less exclusive criterion of selection was applied and the beneficial results were immediately felt . . .⁹

In the early history of the basic sciences in Venezuela, as well as the early history of technology and industry, foreign as well as the *criollo* pioneer-teachers, scientists and technologists played an important part; they brought with them ideas, modes of thought and techniques acquired through their foreign experiences and conceptions of work which were new to the country. The sizeable number of foreign scientists and technologists who came as immigrants played an important part.¹⁰ We may mention Rudolf Jaffé, a German anatomo-pathologist brought to Venezuela in 1936 to do research in a private clinic; he was important in the development of pathology and anatomy in the country. Augusto Pi Suñer, from Catalonia, arrived in Venezuela in 1939 at the age of 60, after a successful career in Spain. He had been invited to Venezuela by Enrique Tejera, the Minister of Education, whom he met during the Spaniard's exile in France from Franco's dictatorship. Pi Suñer created the Instituto de Medicina Experimental in the Universidad Central in 1940, where the modern study of physiological sciences began in Venezuela. Martin Mayer, a German scientist from the Tropical Institute of Hamburg, also arrived in 1939 and worked at the Instituto de Higiene; he had a brilliant local pupil, Félix Pifano, who later founded the Instituto de Medicina Tropical of the Universidad Central. Karl Goede, a German biochemist, was employed by the Ministry of Health to organise clinical laboratories, but he wished to do research and eventually created a notable school of biochemists. Nikita Czyhrinciw, a Russian food technologist, worked first in private industry and later organised the laboratory of food technology in the science faculty of the Universidad

⁸ Berglund, S. and Hernández, H. "Estudio analítico de la política inmigratoria en Venezuela" (Caracas: Consejo Nacional de Recursos Humanos and Ministerio de Relaciones Interiores, 1977); also Schloeter, M., Suárez, M., and Torrealba, R., "Selective Latin American Migration in Venezuela: The Case of SIDOR", in Marks, A. and Vessuri, H. (eds), *White Collar Migrants in the Americas and the Caribbean* (Leiden: Royal Institute of Linguistics and Anthropology, 1983), pp. 207-210.

⁹ Betancourt, R., *Venezuela, política y petróleo* (Barcelona and Caracas: Seix Barral, 1978), p. 524.

¹⁰ Vessuri, H. "Scientific Immigrants in Venezuela; National Identity and International Science" in Marks, A. and Vessuri, H. (eds), *White Collar Migrants*, pp. 171-198. Aráujo, O., *La educación en el Estado democrático* (Caracas: Universidad Central de Venezuela, 1983), pp. 107-141.

Central. Henri Pittier, a Swiss botanist, lived in Venezuela from 1919 until his death in 1950, creating modern botanical research in the country. Augusto Bonazzi, an Italian chemist, arrived in 1937 and had a varied career, working first in the Ministry of Agriculture, then in the faculty of agronomical engineering of the Universidad Central, and later as professor of the faculty of pharmacy and director of the institute of chemistry of the science faculty.

There were many immigrant teachers in the early days of the faculties of engineering and of science. Among the students of scientific subjects, the children of European immigrants were conspicuous. The proportion of scientists of the second and third generation of immigrants from Europe, or with European training, continued to be high in comparison with other fields of activity. Between 1955 and 1975, university enrolment grew by 2,183 per

TABLE I
Higher Education in Venezuela, 1981—82

University	Foundation (Date)	Status	Students (Number)	Teachers (Total FTE or individual)
Central de Venezuela	1721	Public	52,070	6,987
de los Andes	1810	Public	29,106	2,713
del Zulia	1958	Public	49,960	3,265
de Carabobo	1958	Public	41,932	2,148
de Oriente	1959	Public	22,265	1,528
Lisandro Alvarado	1967	Public	13,662	945
Simón Bolívar	1969	Public	6,962	792
Simón Rodríguez	1974	Public	6,442	371
Nacional Experimental del Táchira	1975	Public	1,776	184
Ezequiel Zamora	1976	Public	2,872	326
Nacional Abierta	1977	Public	6,658	316
Francisco de Miranda	1978	Public	642	132
Rómulo Gallegos	1978	Public	364	65
Católica Andrés Bello	1953	Private	8,324	633
Santa María	1953	Private	14,863	516
Metropolitana	1970	Private	3,001	253
Rafael Urdaneta	?	Private	1,957	228
Tecnológica del Centro	?	Private	98	23
Total			262,954 ^a	

^a Total of students in state universities: 234, 711. Total in private universities: 28,243. Percentage of total formed by students of Universidad Central: 19.8.

SOURCES: Consejo Nacional de Universidades. Oficina de Planeamiento del Sector Universitario. *Boletín estadístico no. 9* (Caracas: 1983).

cent and in the sciences and engineering by 2,458 per cent.¹¹ Immediately after the fall of the dictatorship in 1958, the elimination of fees and the return of many political exiles, among other factors, resulted in considerably increased affluence among students of the Universidad Central. The growth of secondary-school education soon produced even more university students.

There was a corresponding expansion of the teaching staff. In the Universidad Central, by 1957 there were 860 teachers, of whom 642 were full time. In the University Law of 1958, the status of the full-time teachers was clearly defined; one of its aims was the gradual transformation of most of the teaching staff into full-time teachers in the university. This expansion of the teaching staff was made possible at first by the availability of foreign teachers; thus in the Universidad Central in 1963 there were 154 teachers of foreign nationality, some of whom were persons of international repute. Later, appointments were increasingly made from among the graduates of the Venezuelan universities (Table I).

The Movement to Promote Research

The most important and influential scientific institutions of present-day Venezuela were founded in the 1950s. The Asociación Venezolana para el Avance de la Ciencia (AsoVAC), was founded in 1950, as a private non-profit organisation.¹² It soon became an important forum for the discussion, promotion and justification of scientific activity through the publication of *Acta Científica Venezolana*, a multidisciplinary bi-monthly journal which has been published since 1950 and which is cited in journals recording international scientific activity, such as *Index Medicus*, *Chemical Abstracts*, *Mathematical Index*, *Physical Reviews* and *Current Contents*. The association also organises annual meetings which for 34 years have attracted most scientists in the country.

Its initiator was Francisco De Venanzi, then a young physician. From 1942 to 1944 he had studied nutrition and endocrinology at Yale University, on a postgraduate scholarship of a programme of the Rockefeller Foundation for Latin American countries, aimed at improving the training of young physicians in various branches of medicine. Pi Suñer, through his personal contacts, had managed to get a fixed allocation of one scholarship from the Rockefeller Foundation to be rotated among the various medical areas that needed to be reinforced locally. De Venanzi was the second holder of the

¹¹ UNESCO, *Statistical Yearbooks*, several years (Paris: UNESCO). The data are analysed in Vivas, J., "Formación universitaria en ciencias e ingeniería y el sistema científico-tecnológico en América Latina", paper presented at the seminar "University and Development in Latin America and the Caribbean", organised by CRESALC, Caracas, RLA/79/007-ECLA-UNDP-UNESCO, 1979, unpublished.

¹² On the evolution of AsoVAC, see Ardila, M., *Origen y evolución histórica de la Asociación Venezolana para el Avance de la Ciencia*, unpublished licenciatura thesis, Caracas, Universidad Católica Andrés Bello, 1981.

scholarship from the faculty of medicine and, after receiving his master's degree from Yale, he spent until 1945 learning techniques in endocrinology at hospitals in New York and New Haven and at the Research Institute of Public Health in New York. He then returned to Caracas. In 1949 he went back to the United States to take a course on the use of radioisotopes in the Veterans Administration Center at Los Angeles.¹³ During his stay abroad he had become a member of the American Association for the Advancement of Science, and he had also become familiar with the efforts being made in other parts of Latin America to promote the growth of science. (The Asociación Argentina para el Progreso de la Ciencia had been created in 1933 and the Sociedade Brasileira para o Progresso da Ciencia (SBPC) in 1948.¹⁴)

De Venanzi made contact with a number of interested scientists and physicians to whom he proposed his project for a local association for the promotion of scientific activity. He had in mind a society in which the active scientists in the country could come together to discuss scientific matters, to raise the level of scientific discussion through the publication of a journal, and to develop the new teaching and research institutions needed in order to establish modern scientific research in Venezuela. As a result of a rapid review of the publications of resident Venezuelans, he estimated that the number of scientists doing research in medicine, agronomy, veterinary medicine, biology, chemistry and geology was about 80.¹⁵ Fifty-nine persons, many of them professionals in fields like medicine, chemistry, pharmacy and agronomy, signed the constitutive act of the association on 20 March, 1950.

AsoVAC was the first Venezuelan scientific body aiming at giving coherence and direction to the future development of scientific activity in the country. In principle, it neither conducts nor subsidises research, but it does afford a forum for the discussion of ideas and projects bearing on science and technology; it has been a key institution in the elaboration of a scheme for analysing the place of science in Venezuelan society. Despite fluctuations in fortune, its actions and influence have continued down to the present, when its 3,500 members, mostly scientists or advanced students of scientific subjects, spread over the whole country, are the main collective voice of the fledgling national scientific community.

The association comprises seven chapters situated in the Federal District, the states and the national territories, which work closely with the universities; each chapter is autonomous with respect to the organisation of its own activities. It has a national executive secretary who is also the general secretary of the Caracas chapter. Each year elections are held for membership of the governing committee in the local chapters and of the Consejo

¹³ Antillano, P., *op. cit.*, pp. 32–36.

¹⁴ Botelho, J., *Evolution de la Société Brésilienne pour le progrès de la science*, unpublished Thèse de Maîtrise, Paris, CNAM, 1983.

¹⁵ De Venanzi, F. "Veinticinco años de ciencia con AsoVAC", *El Nacional*, 16 October, 1975.

Directivo Nacional. AsoVAC has representatives in governmental institutions such as the Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT), which aim to promote the development of scientific research in public and private institutions. It organises conferences, round tables, etc., and prepares reports on scientific and technological problems of public importance. It belongs to the Asociación Interciencia, a federation of societies for the advancement of science in the Americas.

The Fundación Luis Roche: In 1952, when the Universidad Central de Venezuela was suspended by the dictatorial military government that ruled Venezuela between 1948 and 1958, the handful of scientists doing research at the university were prevented from entering their laboratories. Their work came to a complete halt.

It was in these circumstances that a small group of the scientists—helped by the generous financial support of a philanthropist, Luis Roche, who was the father of one of the group—established a private research foundation for the study of common endemic tropical diseases, such as hook-worm anemia, schistosomiasis and certain other common diseases such as diabetes and endemic goitre.¹⁶

Although the foundation was short-lived, lasting only for six years from its early informal days of 1952 to its dissolution in April 1958, it had lasting value; in addition to the useful research it carried out, it provided administrative experience, and a training in thinking about science as research, for a number of men and women who later were influential in science policy and in the formation of Venezuelan scientific institutions. Among the members of the foundation were Francisco De Venanzi and Miguel Layrisse, who after 1958 became rectors of the Universidad Central de Venezuela from 1958 to 1963 and from 1976 to 1980 respectively; Miguel Layrisse, Marcel Roche, Raimundo Villegas and Luis Carbonell served as directors, in succession, of the Instituto Venezolano de Investigaciones Científicas (IVIC) from 1959 to 1984. Marcel Roche and Miguel Layrisse also served in succession as presidents of CONICIT from 1969 to 1975. Raimundo Villegas and Luis Carbonell have also served as ministers of state for science and technology. A few others served as heads of departments, chiefly at IVIC and the Universidad Central.

The dissolution of the Fundación Luis Roche in 1958 was a direct consequence of the creation by the government of the Instituto Venezolano de Investigaciones Científicas; the director of the latter, Marcel Roche, was called upon to organise the new institute and he and many of the foundation's staff moved into the larger institution. The rest, led by De Venanzi, associate director of the foundation, moved into the Universidad Central with the task of reorganising it. The Fundación Luis Roche had 35 members of staff, eight of whom were research workers, seven students and

¹⁶ Roche, M., "El discreto encanto de la marginalidad. La Fundación Luis Roche", in *C y T*, II, 1 (1984) (part 2 in press).

seven technicians; IVIC has today over 100 scientists who, with the professionals associated with research activities, graduate students and technicians, come to more than 600 persons.

Instituto Venezolano de Investigaciones Científicas: In 1954 the Jiménez government founded the luxurious Instituto Venezolano de Neurología e Investigaciones Cerebrales (IVNIC) around the figure of the dictator's friend, the eminent biologist and specialist in electronic microscopy, Humberto Fernández Morán; in the early 1950s, when he promulgated the institute's project, Morán was doing research at the Karolinska Institutet of Stockholm. Although initially IVNIC was intended to be specialised in this very narrow area of science for which the only trained person in the country was Morán himself, in 1955, under President Eisenhower's programme of Atoms for Peace, a project for the construction of a nuclear reactor was started at the institute in accordance with an idea of Pérez Jiménez.

The institute was provided with a magnificent setting and good buildings but very little research was carried out and the four scientists—and 200 technicians—developed no links with the small local scientific community, perhaps because only one of them, Fernández Morán himself, was Venezuelan, and he was politically tarnished by his association with the military dictator for whom he was also Minister of Education at the time of his fall. In 1958, the new democratic government decided to transform the IVNIC into the central institution for research in basic science in Venezuela. It put it in the charge of Marcel Roche, who had shown his qualities not only as a scientist but also as an organiser and administrator during the years of the Fundación Luis Roche.

Roche was a young Venezuelan medical scientist educated in France and at the Johns Hopkins University in the United States. When he returned to Venezuela, he considered that his field of specialisation in goitre made no sense in local circumstances, and so began to do research on bilharzia and leishmaniasis. He produced works that are still standard authorities in the field of tropical medicine, but his chief impact on Venezuelan society has been through his contribution to the formation and management of scientific institutions. He was the organiser of the Fundación Luis Roche, the first president of CONICIT, the founder of the department of science studies at IVIC, the founding editor of *Interciencia*—the journal of the Interciencia Association—and he is at present ambassador of Venezuela to UNESCO in Paris.

Created in 1959, at a time of political enthusiasm for the newly established democracy and for the modernisation of the economy and social life of the country, IVIC was one of the first centres in Venezuela which had scientific research as its exclusive aim¹⁷ and a staff of full-time scientists to do

¹⁷ On the evolution of the institute, see Antonorsi, M., "Diagnóstico histórico del Instituto Venezolano de Investigaciones Científicas" Caracas, mimeo, 1977; Vessuri, H., "La investigación química en el IVIC", mimeo, Caracas, 1979; Freitas, Y., "La institucionalización del ethos de la ciencia: el caso del IVIC"; Vessuri, H. (ed.) *Ciencia Académica en la Venezuela moderna*.

research exclusively. With the new faculty of science of the Universidad Central, they formed the institutional matrix for the implantation and development of scientific research. They succeeded in doing so, not only because of the internal teaching and research activity at both institutions, but also because of the roles their members played in the creation and consolidation of science departments and research groups in the other national universities.

All the current schools of science in the country began their own activities several years after these two institutions, and with practically no exceptions their organisers and early staff were graduates and research workers from both the Universidad Central and IVIC. These persons have also been decisive in the creation of the new research institutions that have emerged in the last two and a half decades. Among them are Néstor Barroeta, a graduate of the science faculty of the Universidad Central, later a chemist at IVIC and then co-founder of the Instituto Venezolano de Tecnología del Petróleo (INTEVEP) in 1976; Raimundo Villegas, a physician from the Universidad Central, and later a research worker and director of IVIC, founder of the Instituto de Estudios Avanzados (IDEA) in 1979; and Roberto Callarotti, an engineer educated at the Universidad Central and for many years a research worker at IVIC and then, in 1980, founding director of the Instituto Fundación de Ingeniería which is situated near IVIC.

Most of the theoretical, conceptual and operational problems which have occurred in the course of the effort to develop modern scientific study and research in the Venezuelan periphery have in fact been the problems of the IVIC and the Universidad Central. IVIC was the product of actions both of the international agencies which took science and technology into their jurisdiction after the Second World War—mainly UNESCO—and of a local group committed to the construction of a “centre of scientific excellence” conducted by Venezuelans. By this was meant a centre that drew on scientists of good quality of indigenous and foreign origin, observed and propagated the best available standards of international science, and aimed to serve as a model of good scientific practice in the country. The evaluative criteria established by IVIC’s Internal Classificatory Commission—formed soon after its establishment—the definition of a “research worker”, and the classification of scientists by rank, formulated by this commission, helped to crystallise the conception of excellence at IVIC. This commission stipulated that scientific productivity be specifically taken into account in assessing candidates for appointment and promotion.

IVIC was organised for academically trained scientists to carry out basic research. Research problems there were dealt with because of their basic scientific importance. Its activities were conceived and developed in isolation from Venezuelan industry which, in so far as it needed scientific knowledge, depended almost exclusively on imported knowledge. Although some of the projects at IVIC were classified as “applied”, the majority were undertaken because they seemed to be good scientific ideas without

reference to their economic value. The goal was clearly to do the research first and then try to see whether its results could be applied; the result was that even the small amount of research which was not fundamental was applicable only in principle rather than in fact. A survey made by CONICIT in 1975 showed that 81.2 per cent of all its projects had been in basic research, and that 76.6 per cent of the budget had gone into basic research. Although the resources for applied research had been doubled in 1970, the bias towards basic research in the institute was still very pronounced.¹⁸ The concentration on basic science conducted in accordance with very strict standards was justified in the 1960s and 1970s as part of the effort to implant scientific activity in institutions with little tradition of experimental research, with weak standards of quality and feeble habits of disciplined scientific work. IVIC, being relatively free from the turmoil of the faculty of sciences of the Universidad Central at a time when universities were suffering the effects of growing student numbers, tried to constitute itself as a model of scientific research of high quality. Its research staff defined itself as a scientific elite; it took for granted with varying degrees of modesty that other local scientific institutions accepted it at its own evaluation.

Nevertheless, its directors, who were all originally medical scientists specialising in basic research in biology, gradually moved in their science-policy activities towards the promotion of applied research, at first within the scope of IVIC, and later on a national scale. Thus, Dr Roche, towards the end of his term as director of IVIC during the second half of the 1960s, promoted the creation of a technological centre within the institute; this centre became operative during Villegas's term of office. While Villegas was the Minister for Science and Technology, he created the Fundación Instituto de Ingeniería; Carbonell, the current Minister for Science and Technology has taken for the leitmotif of his programme the development of applied and industrial research. Dr Roche has explicitly admitted a change of mind about the responsibilities of scientists, and if he were to start all over again he would start with a different idea of science policy. Dr Roche's uncertainties express the fundamental dilemma of scientists and those responsible for scientific policy in peripheral countries.

The antecedents of the faculty of science at the Universidad Central: The institutional establishment of the basic sciences in Venezuelan universities is to a large extent a phenomenon of the last three decades. Until the middle of the present century, scientific disciplines were taught in faculties of engineering and medicine as supplements to the training of future engineers and physicians.

At the end of the 1940s and the beginning of the 1950s, a few Venezuelans who had studied the basic sciences abroad, mainly in the United States, and a few foreign technologists and scientists who were living in the country, were actively engaged in a project that culminated in the creation of the faculty of sciences in the Universidad Central de Venezuela

¹⁸ Antonorsi, M., *op. cit.*, pp. 29–30.

in 1958. Their aim was to create an institutional setting for the pursuit of pure science; they argued that a modern society without a scientific community would be too dependent on the outside for the solution of its greatest problems and would be unduly under the influence of narrow economic interests.

In 1946, the council of the Universidad Central established a school of science, attaching it to what was then the faculty of physical sciences and mathematics, but which, despite its name, was exclusively engaged in the training of engineers. It was decided that such a school should bring together the departments of mathematics, geology, physics and chemistry, which were already in existence in the old faculty, and a new department of biology. The dual task given to the faculty was to continue to train engineers and to begin to train scientists. This led to its being renamed in 1950, as the faculty of mathematical and natural sciences and, then, in 1953, as the engineering faculty. However, in 1951, there was already debate in the university council about the desirability of creating a faculty of sciences to be separate from that of engineering.

The faculty of medicine did not think there was a need of such a new faculty, for it considered that the basic sciences, mainly biology, could be taught within its own institutional framework. Some of the leading physicians in the university council argued that the time was not ripe for a new faculty. A group of chemists in the faculty of pharmacy and the biologists, mathematicians and physicists who were confined to the faculty of engineering, pressed for a faculty in which science as a whole could be cultivated for its own sake and not as auxiliary knowledge for the training of engineers and physicians. A project led by an influential biologist, Tobías Lasser, favoured the creation of a specific institutional base to train young persons for careers as scientists. Among the documents produced on the occasion of this debate, one of 1952 pointed out that after six years in which the school of sciences had been operating as part of the engineering faculty—actually this name was officially given only in 1953—the department of biology was the only unit that had provided a syllabus for the *licenciatura en ciencias biológicas*, had produced graduates and had a stable number of students enrolled in each of its courses.¹⁹ The departments of mathematics, geology, chemistry and physics continued, instead, along the old line of offering auxiliary training to technologists without extending their functions to the training of research workers and teachers in these branches of knowledge.²⁰

¹⁹ For a historical account of the school of biology in the Universidad Central, see Texera, Y., "La biología en un contexto periférico: el caso de la Escuela de Biología de la Universidad Central de Venezuela", Vessuri, H. (ed.), *Ciencia académica en la Venezuela moderna*, pp. 47–76.

²⁰ Vessuri, H., "La Facultad de Ciencias de la UCV en la transferencia de conocimiento científico a Venezuela", unpublished, Caracas, CENDES, 1984. On the evolution of the modern teaching of engineering in the Universidad Central, see Licha, I., "La enseñanza de la ingeniería en Venezuela. ¿Investigación o innovación?", in Vessuri, H. (ed.) *Ciencia académica en la Venezuela moderna*, pp. 77–102.

The next steps in the gestation of the current faculty of sciences were the creation in 1955 of qualifications for academic careers of physics and mathematics with the *licenciatura en ciencias* within the school of sciences of the faculty of engineering and the transfer to the same faculty, in 1956, of the school of chemistry that had been functioning in the faculty of pharmacy since 1950.²¹ In the same year the school of sciences changed its name to that of school of biology; a new school of physics and mathematics was created, and it was officially decreed in the *reglamento* of the faculty of engineering that these three schools—chemistry, biology, and physics and mathematics—would remain part of the faculty until the creation of the new faculty of sciences. This was confirmed by agreement no. 63 of the university council at a meeting on 3 March, 1958, presided over by Dr De Venanzi.

Attitudes and Beliefs about Research in the 1950s

The aim of the persons who were active in the creation of these various institutions was to establish conditions for the development in Venezuela of a body of properly trained scientists who would work full time on research, in marked contrast to the still prevailing practice of research as a supplementary or leisure-time activity. The programme was an optimistic one, indeed a bit naïve, in its belief in a direct connection between scientific research and economic development. Those who espoused this programme rejected what they considered to be a petty, individualistic, utilitarianism which they thought characterised the liberal professions of medicine and law. They argued that there was a deeper kind of practical utility in fundamental scientific activity which would lead to national economic and social well-being.

Physicians, engineers and lawyers were graduating in growing numbers, but until the creation of the faculty of sciences at the end of this period there was no institution within the university system nor in Venezuela as a whole for the training of future scientists. There was a growing feeling within the intellectual and medical elites that the liberal professions had to open the way to scientific research in order to avoid “stagnation and excessive utilitarianism in its ranks”.²²

The biologist Tobías Lasser, director of the department of biology in the Universidad Central, was one of the most fervent promoters of the creation of the faculty of sciences. In 1952, he said at the annual meeting of the Asociación Venezolana para el Avance de la Ciencia (AsoVAC) held in Caracas:

A quick look at our scientific landscape reveals that psychologically we have been dragged along in the last 50 years by a strong tendency to favour and give our strongest preferences to technology instead of to science proper. We have been

²¹ Vessuri, H. and Safar, M., “Elementos para la historia social de la química en Venezuela” in Díaz, E., Texera, Y. and Vessuri, H. (eds), *op. cit.*, pp. 121–165.

²² Gabaldón, A., “Sobre el progreso de la ciencia en Venezuela”, *Acta Científica Venezolana*, X (August 1959), pp. 58–59.

dominated by this mistaken preference for the useful and the easy at the cost of the true and the deep. The utilitarian feeling that dominates us is responsible for our scientific situation, for, like a mermaid's song, it has diverted the path of Venezuela's scientific vocation towards ephemeral triumphs . . . Our university is preparing outstanding practitioners of medicine, engineering, law, etc., but the foundation of this preparation is technology which we might define as applied scientific knowledge. We borrow techniques from other countries that possess a great scientific heritage. We believe that Venezuela, because of its tradition and ideals, because of its wealth and its population, cannot continue to live on intellectual borrowings. We must systematically reorganise scientific research, under the tutelage of a faculty of sciences, with well-coordinated departments for the basic sciences . . . where at the same time that these sciences are taught, students will be provided with a scientific attitude and a scientific method which will enable them to interpret the physical reality of Venezuela . . .²³

In 1960, at another annual meeting of the AsoVAC, an eminent physician, Dr Humberto García Arocha, warmly defended the importance of the recently created faculty of sciences for the training of research workers capable of doing original work. He remarked that the common view of the physician as the ideal for research workers was mistaken; he insisted that the career of the medical practitioner was neither superior nor inferior to a career in scientific research. They were simply different.

In 1957, Luis Carbonell, who was secretary-general of AsoVAC and who is now Minister for Science and Technology, expressed his hope that there would be a steady increase in basic research, which had "hardly begun among us".²⁴ He said that most of the papers submitted at the annual meeting of the association were the result of "well organised and deserving professional activity, not of a direct effort to do scientific research".

The challenge facing the promoters of science in those recent—but for Venezuela, early—years was to arouse and guide the interests of young persons towards scientific work and away from the then predominant preference for careers in medicine and engineering. It was argued that Venezuela, by contrast with other peripheral countries, did not lack the economic resources to support scientific activity. Its weakness, rather, lay in the absence of possible careers in science and the unwillingness of young persons to become scientists.²⁵

In 1959, Arnaldo Gabaldón, a physician who had been active in the successful campaign by the government between 1936 and 1950 to eradicate malaria in Venezuela, put forward an argument similar to Lasser's at the beginning of the decade. For Gabaldón, the economic condition of the country at the time had a paradoxical influence. Although scientific research

²³ Lasser, T., "Palabras del Dr. Tobías Lasser con ocasión de la apertura de la II Convención Anual de la Asociación Venezolana para el Avance de la Ciencia", *Acta Científica Venezolana*, III (March–April 1952), pp. 37–39.

²⁴ Carbonell, L. M., "Palabras del Secretario General de la AsoVAC en la sesión inaugural de la VII Convención Dr. Luis M. Carbonell", *Acta Científica Venezolana*, VIII (August 1957), pp. 97–98.

²⁵ For an exposition of the social change resulting from economic expansion, see Uslar Pietri, A., *De una a otra Venezuela* (Caracas: Monte Avila Editores, 1984).

had been given adequate financial resources, the desire for wealth had grown so enormously with the affluence generated by the revenue from oil, that young persons with scientific capacities devoted themselves “immoderately and exclusively to the pursuit of wealth. It is alarming to see the waste of scholarships that are being offered by us and are not taken up, or, when they are used, it is only to pursue studies that will produce quick economic returns . . .”. The scientist who interested himself in the development of science in Venezuela was distressed by:

knowing that there are resources for research while there is a lack of persons willing to make use of them. Notwithstanding the fact that we get great benefits from the foreign scientists who have come and should continue to come, it is also true that our effective progress will depend on the number of young Venezuelans who devote themselves with keen interest to scientific pursuits.²⁶

As a result of these arguments, the programme of action on behalf of science concentrated on giving all possible support to university courses of study in the basic sciences where students would be trained in experimental disciplines, would have to work on research problems in order to obtain degrees, and would then be granted the necessary support to enable them to devote themselves entirely to advanced teaching and original inquiry.

Scientific teaching and research would contribute to the realisation of the ideals of national autonomy and development; this was how science was justified. In the pursuit of this objective, a proposal for the creation of the Consejo Nacional de Investigaciones Científicas was submitted in 1958 by AsoVAC to the provisional government which succeeded the military dictatorship. Among the projects included in the proposal were:

the study of the rational use of the fauna and flora of Venezuela, oceanographic studies, pharmaceutical production using indigenous raw materials, the development of native industries exporting to foreign markets, agronomical studies of tropical soils, research into local medical problems, the adequacy of teaching by means of research, and sociological studies about the Venezuelan people.²⁷

Increasing Momentum of the Provision for Research

In the 1950s, the idea that the country's development ought to be planned slowly matured; the idea was embodied in a number of institutions and acts of legislation. In 1958, Oficina central de Coordinación y Planeamiento de la Presidencia (CORDIPLAN)—the Presidential Co-ordinating and Planning Office—was created to apply in Venezuela some of the notions that the United Nations Economic Commission for Latin America had been putting forward for some time. In 1960, CENDES, the centre for development studies, was founded at the Universidad Central, to provide the theoretical ideas and the fundamental analytical and descriptive studies necessary to embark on programmes of development; CENDES was also to train the economic and social planners required to design and execute the plans.

²⁶ Gabaldón, A., *op. cit.*, pp. 58–59.

²⁷ AsoVAC archives.

As far as the university system was concerned, the promulgation in 1958 of a new University Law—in the elaboration of which De Venanzi's role was paramount—declared research to be one of the basic tasks of universities. In accordance with this declaration, the Consejo de Desarrollo Científico y Humanístico (CDCH)—the Council for Scientific and Humanistic Development—was created in the Universidad Central in the same year, to foster and co-ordinate research activities in the sciences and in the humanities. Since then, this council—similar bodies were later established in the other national universities—has granted subsidies for research, postgraduate fellowships, grants for sabbatical years and shorter research trips for university teachers, and institutional grants for the improvement of laboratory equipment and buildings.

At this time, neither CONICIT nor any other significant agency for the support of science existed in the country. During the first five years of its existence from 1958 to 1963, it financed 122 research projects, 24 of which were carried out in the science faculty, 27 in the faculty of medicine and 16 in the engineering faculty. Another invaluable contribution of the CDCH was its fellowship programme to train teachers abroad. Even today, when CONICIT awards 200 fellowships for the entire country, the CDCH offers about 120 fellowships for teachers of the Universidad Central.²⁸

The enthusiasm for planning and for scientific and technological development was equally reflected in the various projects for the establishment of research councils. The earliest had been proposed in 1949 to the military junta, then in power, by Professor Gabriel Trómpiz, and was dominated by a "national utilitarian philosophy". In 1950, a UNESCO expert, Torbjorn Caspersson, presented a second proposal, which was eventually accepted almost 20 years later,²⁹ when the science council, CONICIT, was created.

Ever since its inception, AsoVAC had been demanding a national research council. In 1958, it submitted a project to the national government, jointly with the universities and the *colegios profesionales*—the professional associations. That same year, the Colegio de Ingenieros—the engineers' association—made public another project on the same lines. In 1962, these two projects were discussed in the Primera Reunión de Científicos, Educadores y Empresarios para el Desarrollo Económico—the first meeting of scientists, teachers and businessmen for economic development—that took place at IVIC under the auspices of AsoVAC, the federation of business associations (FEDECAMARAS), IVIC and the Universidad Central. A third project, prepared by the Ministerio de Fomento—Ministry of Industry—for a "co-ordinating council of technological and industrial research" was also submitted to this meeting. After two years of careful

²⁸ Cortés, L., "Historia y proyección del Consejo de Desarrollo Científico y Humanístico", *Universidad Nuestra: Revista de la APUCV*, VII (June 1981); De Venanzi, F., *Mensaje al Claustro* (Caracas: Universidad Central de Venezuela, 1963).

²⁹ Texera, Y., "Ciencia e ideología: antecedentes de la creación del CONICIT venezolano", in Díaz, E., Texera, Y. and Vessuri, H. (eds), *op. cit.*, pp. 167–198.

analysis the mixed commission appointed at the meeting in 1962 proposed a council very similar in function and composition to CONICIT; it was to be attached to the Ministerio de Fomento. The full report was produced in 1964 and published as a book a year later.³⁰

In 1964 a mission from UNESCO arrived in Venezuela to review this proposal and to suggest steps for its realisation. The mission recommended a number of modifications in the proposal of the mixed preparatory commission of CONICIT; these modifications, reminiscent of Torbjorn Casperson's project, tended to reduce the role of industry, commerce and technology in its management.³¹ After a long series of negotiations, the law that created CONICIT was promulgated in 1967 and came into effect in 1969.

The decade of the 1960s also saw an effort to reform the educational system. A variety of interests and institutions were active in this campaign, ranging from universities, the federation of business associations (FEDECAMARAS), the political parties, the Rockefeller Commission, the ambassador of the United States, Teodoro Moscoso, and the central government.³² The large American foundations sent groups of experts. Co-operative programmes were established. One of these was the formation in 1963 of the second science nucleus in the school of sciences at the Universidad de Oriente through a joint programme of the local university, the Ford Foundation and the University of Kansas. The Ford Foundation was also influential in the introduction of new teaching methods in chemistry, in the provision of subsidies for laboratories and research equipment in the faculties of sciences and engineering of the Universidad Central, and also in the granting of scholarship to study in the United States.³³

All these activities were accompanied by changes in the provisions for study and teaching at the university. With the enactment of the new University Law in 1958, the university councils issued new regulations. Traditional courses of study gave way to a variety of courses which permitted a flexible approach to the requirements made of the students. A combination—not always successful—of the faculty system and that of departments was undertaken; a department was defined as a set of subjects grouped into a single discipline. Curricula were modified and new special subjects introduced. The recruitment of foreign scientists to initiate new lines of research was a feature of this movement. There was an increase in the number of research facilities, institutes, study centres and laboratories. The 1960s were also marked by the growth of the faculty of sciences of the Universidad Central and of IVIC, the Venezuelan institute of scientific research. The activities of these two institutions were conceived as complementary. It was

³⁰ Comisión Preparatoria para el Consejo Nacional de Investigaciones Científicas y Tecnológicas, *La ciencia base de nuestro progreso* (Caracas: Ediciones IVIC, 1965).

³¹ Texera, Y., *op. cit.*, pp. 191–192.

³² Sáez Mérida, S., "Crédito educativo y modelo tecnocrático", *Cuadernos de Educación*, LXIII–LXIV (March–April 1979), p. 129.

³³ Vessuri, H., "La Química en Venezuela, 1938–1980", unpublished Caracas, 1984.

expected that both would function in close association, sharing the responsibility of teaching and training the students at undergraduate and postgraduate levels, as well as retraining teachers of science in the laboratories of both institutions.³⁴ But things did not turn out that way; to a large extent both institutions have competed for undergraduate students to serve as laboratory workers. In research, there was less co-operation between them than was envisaged.

Both institutions offered fellowships for young scientists to study abroad.³⁵ When the fellows returned, they were largely absorbed into their respective institutions or in the new schools of science that were beginning to emerge throughout the country. By 1970 there were already 213 research workers with masters' degrees or doctorates in the biological sciences, including medicine, 221 in the physical sciences and mathematics, including the engineering sciences; there were 80 in the social sciences and the humanities, making a total of 514 persons with postgraduate degrees.³⁶

Partly as a result of the growing numbers of holders of the doctorate in scientific subjects, the faculty of sciences in the Universidad Central created research groups. Many of these were not inferior in quality and productivity of those of IVIC. This was a noteworthy achievement since the practically exclusive function of IVIC was research and its staff-members, if they had any teaching duties, taught with few exceptions only at postgraduate level and in close connection with the research being done at the institute.

The Separate Ways of the Universidad Central and the IVIC

Competition between IVIC and the faculty of sciences of the Universidad Central has continued to this day. It is expressed in disputes about the relative productivity of the two institutions in research,³⁷ the relative intellectual importance of the topics investigated, and their social significance through teaching. Nevertheless, there have also been examples of fruitful co-operation in teaching and research.

During the 1960s, the two institutions were actively engaged, although in different ways, in the debates about the reform of the educational system and the development of science in Venezuela. While many university teachers took the lead in movements for fundamental and far-reaching social

³⁴ The faculties of sciences at the other national universities were projects for the future while in the Universidad Central there were already nuclei that could be expanded immediately. See Texera, D., "Pasado y presente de la Facultad de Ciencias (UCV)", *Acta Científica Venezolana*, XIX (1968), pp. 96–98.

³⁵ Díaz, E. and Vessuri, H., "La formación del investigador científico básico a través de los programas de becas nacionales. El caso de los químicos", *C y T*, II (1984), pp. 18–27, (second part in press).

³⁶ Arnau de Uzcátegui, D., et al., *Diagnóstico de la actividad de investigación y desarrollo experimental que se realiza en el país* (Caracas: CONICIT, 1973), p. 128.

³⁷ Camejo, G., "IVIC versus UCV" (Letter to the Editor), *Inter ciencia* VIII, (January–February 1983), p. 6; Roche, M. and Freites, Y., "Producción y flujo de información científica en un país periférico latinoamericano", *Inter ciencia*, VII (September–October 1982), pp. 279–290.

transformation, the members of IVIC held themselves aloof from such movements; instead they gave technical advice to the higher levels of government.

Ever since the opening of the democratic era in 1958, the Universidad Central had enjoyed intellectual freedom and open discussion of its role in society as well as in its internal affairs, such as budget, academic reform, and the reform of teaching. But before long, the university became a battlefield in which the political struggle between factions of the left was waged. The *Renovación* of 1967–68 was one of these political movements.

The political objective of *Renovación* was not the integration of the university into the existing society, but rather a change in the internal structure of the university to enable it to criticise and transform society. Its aim was to propagate its conception of “underdevelopment”, of “dependence” and of the structure and dynamics of the world economy. It argued that, in conditions of underdevelopment, all courses of study in all faculties should give precedence to social problems over technical ones. It argued that political choices had to be made first and that only then could solutions of a technical nature be found. In the words of Oscar Varsavsky, the Argentinian mathematical physicist who lived intermittently in Venezuela and who was a spokesman of the movement:

It seems to me that the serious study of national problems would open up many new theoretical paths. Perhaps even Science—with capital letters—might benefit in the long run with the opening of two or three new avenues rather than with the accumulation of efforts in directions that in any case are being followed with greater efficiency in the North. For our countries, the difference is clear: one way we contribute to form a national culture; the other way we are scientific vassals . . .³⁸

The origins of this movement, which has its counterparts throughout Latin America, go back to the Argentinian “*reforma universitaria de Córdoba*” of 1918.³⁹ The achievement of a particular type of autonomy in the Latin American university established a tradition of opposition among university teachers and students towards the governments, and especially to the military dictatorships that at various times have been in power in various Latin American countries. The “politically neutral student” became a rarity. In Venezuela the *Generación del 28* had been a forerunner of *Renovación*. In the late 1950s, Venezuelan students, who had an important part in the resistance to and victory over the dictator Pérez Jiménez, were very politicised. The Cuban revolution of 1959 had an enormous impact on them.

The conservative attitude of the first democratic government following the dictatorship alienated the students from Acción Democrática, which was the governing party. The Movimiento de Izquierda Revolucionaria (MIR), which led the violent struggle against the government, was a creation

³⁸ Varsavsky, O., “Sobre el problema de la dependencia cultural en América Latina”, paper presented at seminar on Latin American cultural autonomy, at Montevideo, March 1968, published in *Universalía*, V, 2 (1968).

³⁹ See “Student Power in Latin America: The Córdoba Manifesto”, *Minerva*, VII (Autumn–Winter 1968–69), pp. 82–87.

of the students. In Caracas, throughout 1960 but especially in October and November, there were a series of violent political actions in which members of the university took a very active part. In 1960, university students joined the more general movement of armed opposition to the government.

The programme of *Renovación* made much of the “dehumanising” consequences of the models of development, modernisation and rationalisation represented by industrial countries; it proclaimed as an alternative, a “self-centred” pattern of development, and recommended violence as the most effective means of political action.⁴⁰

As a political engagement the movement failed. Three universities were occupied by the army between May and October of 1969. New and stringent regulations were decreed in 1970, which made possible governmental intervention into the internal affairs of the university. The radical attack on the traditional structures of the Latin American university and on old-fashioned teachers did not achieve its objectives.

Nevertheless, in the aftermath of *Renovación*, the Venezuelan universities increased their attention to science. They tried to do research in accordance with patterns which they saw practised in the main international centres of research. The publication of the results of research in journals of international reputation became part of the aspirations of the teachers in the more advanced faculties. But, this impulse to do research up to a high standard ran into difficulties. It has been very hard to orient courses of study and research in a way which conforms with standards of high quality and meets criteria of national development with which the government is often unsympathetic. Many “fossils” from the “old guard” of the teaching staff have survived without doing any research at all, and even resisting efforts to promote it. Furthermore, the revulsion against *Renovación* resulted in the departure from the university of some persons of good scientific qualifications and achievements. Many good teachers left, some for personal reasons, some because of professional rivalries and envy. Some of those who remained withdrew into silence.

Renovación had started in the new faculty of sciences, founded in 1958, which at the time espoused socialist views; some of its members were associated with circles around the Communist Party. The movement culminated in the older faculty of engineering where the conflicts were much more intense because the authorities were conservative. A large proportion of the teachers taught only part time, devoting most of their time to private business, and were not sympathetic with any reform of the university, least of all with any fundamental reform. The *Renovación* movement aroused their hostility because it demanded a teaching staff working full time in the university. In the engineering faculty, a number of teachers were dismissed because of their political views; this led to the resignations of many others,

⁴⁰ The *Renovación* movement at the Universidad Central has received little systematic treatment; see however, Silva Michelena, H. and Sonntag, H., *Universidad, dependencia y revolución* (México: Siglo XXI, 1970).

out of solidarity. Many of these engineering teachers left academic life permanently or joined the new "experimental" universities which were created in the 1970s. Others went to IVIC.

Between 1969 and 1971, IVIC appointed a number of the scientists who had abandoned the disrupted university and who sought a more favourable environment for their research.⁴¹ Until then the IVIC had managed to remain free of party politics. In 1966, Marcel Roche, its first director wrote:

I have tried as much as possible to keep IVIC away from partisan politics. The creative intellectual—the writer, the musician, the painter, the scientific research worker—has an important and political role. In the long run, the evolution of society is largely a result of his action, but his position as creator allows him the luxury of acting through his own work and not through a political party . . . What we do at IVIC belongs to the future of our country, and it will be effective to the extent that we can keep our action far from partisan politics. Successive governments and ministers—it must be admitted—have in general left IVIC in peace and have respected it.⁴²

But despite attitudes such as Roche's during the 1960s, arising from a conviction of the high intrinsic value of scientific knowledge and the possibility of keeping it separate from political passions and controversies, it has proved impossible to prevent IVIC from becoming involved in political conflicts. IVIC is a public institution dependent on the Ministry of Health. Its governing authorities aim to obtain a substantial share of the national science budget for IVIC, and legitimate the institute before the public; its leading members are active in the definition and control of national science policy. All these factors made political involvement unavoidable.⁴³

The "New" CONICIT as a Criticism of Fundamental Research

Created in 1969, the Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT) became, in the course of the 1970s, the dominant power in the formal organisation of the scientific community and in the relations of the latter with government. It has had a beneficial influence on the development of science in Venezuela, by fostering public awareness of its importance and by helping to improve the conditions for scientific work through granting funds for research and fellowships and for laboratory equipment, as well as offering postgraduate courses.

Despite these exertions on the part of CONICIT, neither it nor Venezuelan politicians and civil servants have been able to bring scientific and technological research to bear on the solution of problems of the national economy. The plans of development adopted by successive governments have not succeeded in gaining such benefits as this research might have been able to offer. CONICIT has been made into the scapegoat for their failure. Public opinion has tended to regard the advancement of

⁴¹ Vessuri, H., "La investigación química en el IVIC", *op. cit.*

⁴² Roche, M., "Introducción", *Informe Anual IVIC* (Caracas: IVIC, 1966).

⁴³ Freites, Y., "La institucionalización del ethos de la ciencia", *op. cit.*

scientific knowledge as synonymous with the advancement of the practical value of science and technology. It is often said that CONICIT has been unable to put into practice its own policies or the science and technology plans with regard to industrial production and the economy in general.

It may well be that the scientific promoters who created CONICIT and who in 1962 had succeeded in their appeal to businessmen, teachers, political leaders and government officials, did not have the knowledge and skill necessary to realise its practical goals. It is probably true that, when the time came to make practical decisions, they preferred to withdraw into isolation rather than to become involved in the difficulties of a policy which would link scientific research with economic development. But this was to be expected. CONICIT had been established to increase Venezuelan capacity to do scientific research. It was consistent with this intention that it should be governed by a group of scientists who wanted, above all, to do scientific work and who therefore conceived of CONICIT as the source of financial support for scientific activities.

This primary scientific interest of CONICIT made for an uncomfortable relationship between the scientists and technologists within it. The scientists saw CONICIT as an agency for science; the technologists thought that they did not get a fair share of the funds controlled by CONICIT because of the very nature of the institution. This became more evident as the decade went by, and as technological problems increasingly were thought of as in need of solution. Preponderant weight was assigned to technological problems by scientists and engineers who were directly engaged in or otherwise connected with national planning.

With the change of government in 1974, a "technology" group that had first formed primarily in and around CONICIT, saw an opportunity to obtain political support to their own ideas. This movement, known as the *nuevo* CONICIT was led by a young engineer, Luis Matos Azócar, then executive secretary of CONICIT and currently Minister of Planning and a prominent member of the Acción Democrática party. He had the support of Getulio Tirado, an engineer, who is at present a prominent officer in the Consejo Nacional de Bienes de Capital (CONDIBIECA), and Virgilio Urbina, an economist, and current president of CIEPE—Centro de Investigaciones del Estado para la Producción Experimental Agroindustrial—and a group of planners who had been growing in size and influence. The "new-CONICIT movement" reached a high point at the first national congress of science and technology in July 1975, when some 2,300 persons gathered for the discussion of a broad thematic programme; the meeting was held with the support and in the presence of the president of Venezuela and his cabinet ministers. The topics ranged from the general ideas contained in the preliminary version of the document which would later become the First Science and Technology Plan, to the most specialised problems of each sector of the economy.⁴⁴

⁴⁴ Antonorsí, M. and Avalos, I., *La planificación ilusoria* (Caracas: CENDES/Ateneo, 1980).

The "new" CONICIT and its supporters issued a number of documents dominated by a rhetorical emphasis on technology. The trend was not confined to Venezuela; a large literature of this sort appeared throughout Latin America. The basic concern was the achievement of a modern industrial system in a hitherto industrially backward country. This literature gave much prominence to the political, managerial, technological and bureaucratic groups which were to be the main agents of the proposed new order. It was focused on technology policy, organisational problems of research and development, systems-analysis, and technology-transfer; it considered science, if at all, only in its relevance to industry and engineering. It took no interest in science as such. Reflections about science as an intellectual activity were rejected as ideologically pernicious or as practically useless.⁴⁵

According to the new outlook, science properly understood should be treated as if it were synonymous with technology. Transplanted science, its spokesmen said, nurtured as a greenhouse specimen in almost hermetically sealed institutional enclaves does not serve the goals of social and economic development. The substance of scientific knowledge and the rigour of scientific methodology were both disregarded by the purely instrumentalist perspective of the "new" CONICIT. In any case, the impetus of the "new" CONICIT movement soon became exhausted. Two years after the congress of 1975 it was already faltering. The intellectual concerns of this new group of partisans of technology found no sympathetic response in the academic world. The leader of the *nuevo* CONICIT, Matos Azócar, decided to seek allies in government; accordingly the planners and engineers moved closer to the Ministry of Industry. There they were decisive in the creation of the Dirección General Sectorial de Tecnología in 1980; it was intended to promote industrial technology.

The planners and engineers who had been associated with *nuevo* CONICIT were influential in improving the quality of Venezuelan engineering; they also helped to develop consulting firms in engineering and contributed to the emergence and growth of service centres for industrial research such as CIEPE, the foundation for agroindustrial research and consultancy, and the Fondo de Investigaciones Tecnológicas (FINTEC), which was affiliated with the Ministry of Industry.

The scientists, who had always retained the formal control of CONICIT, resented the challenge by the planners and technocrats during the years of the "new" CONICIT, which had threatened the work of the institution which had been given the task of promoting science; but the organisation had withstood the attack. Despite all the rhetoric of their opponents about technology and industrialisation, CONICIT remained under effective control of the scientists; its subsidy for research and its fellowship

⁴⁵ Vessuri, H., "Tres enfoques de la relación ciencia y desarrollo en Venezuela", in Aguilera, M. Rodríguez Lemoine, V. and Yero, L. (eds), *La participación de la comunidad científica*, pp. 43-51.

programmes which insured the support of its scientific clientele continued, without changes in orientation or evaluative criteria.⁴⁶

Although the First National Congress of Science and Technology held in July 1975 was represented as the culmination of a process of growing consensus among scientists, industrialists and government, it was in fact a triumph of the scientists; 74 per cent of the participants were scientists and their outlook prevailed. Scientific activity was beginning by this time to be fairly well established institutionally; it certainly did not correspond to the caricature drawn by some of the partisans of the technological interpretation of science. The presence of scientists already working locally in laboratories with modern equipment, the greater availability of fully trained research workers, and the fact that substantial numbers of young scientists were being trained abroad, laid the foundation for research in applied science of a sort which the *nuevo* CONICIT had been unwilling to acknowledge. The application of original ideas to practical tasks urgently requiring solution was becoming feasible.

The Application of the Results of Research

In this period there were several interesting instances of co-operation between academic scientists and “users”, for example, the work on petroleum and petrochemistry. Research on catalysis began in 1964 at the Universidad Central where Heinrich Noller and Paulino Andréu were working under an agreement with the Technische Universität of Munich, to set in motion a teaching and research programme on this field. The earliest research projects on catalysis had a predominantly academic interest; their chief value lay in their contribution to the formation of a research group. Between 1968 and 1973, a training programme abroad for research students was arranged; the Universidad Central and Universidad de Carabobo participated in this programme. From this early experience, arrangements with a number of foreign institutions were established which have allowed Venezuelan research students to work on catalysis in those foreign institutions. With the return from abroad in 1970 of the first fellowship holders, research began to be reoriented towards problems related to oil and petrochemistry. Studies in catalytic reformation and its circuit were begun, to which studies in desulphuration and demetallisation were then added; later, research turned to the improvement of the heavy oils of the Orinoco Oil Belt.

The removal of Paulino Andréu, the main member of this group, from the Universidad Central to IVIC in 1970 when the research programme was maturing was probably prompted by the increased activity of *Renovación* and the concurrent political disruption in the university. But it was also at this time that the first postgraduate fellows on catalysis who had been sent

⁴⁶ This control is reported in Freitas, Y. and Roche, M., “La planificación de la ciencia y la tecnología en Venezuela: Opiniones de un grupo académico”, in Díaz, E., Texera, Y and Vessuri, H. (eds), *op. cit.*, pp. 199–230.

abroad by the Universidad a few years earlier returned to Venezuela. Their desire to establish their own independent laboratories and lines of research affected the planning of the research programme in the faculty and probably also hurt Andréu's feelings since he was the initiator of the programme. This coincided with the presence at IVIC of Néstor Barroeta, a former IVIC fellow in chemistry who had recently returned from his postgraduate studies at Imperial College, London and was beginning a research programme on an important practical problem in petroleum and petrochemistry. He invited Andréu to join him at IVIC in order to carry out his project; a few other chemists from the Universidad Central moved to IVIC around this time to collaborate with Barroeta and Andréu. Barroeta was working closely with IVIC's authorities on the development of a technology centre—in fact begun in 1971—that would have petroleum and petrochemistry as one of its main lines of work. In 1973, the Chemistry Centre of IVIC became the Centre of Petroleum and Petrochemistry and Barroeta was made its director.

Petrochemical research was allowed to grow in the precincts of the so-called "ivory tower" of IVIC until it acquired sufficient strength and could move on to a new and more appropriate setting. Things were not entirely easy for applied scientists in this academic institution. Since Venezuela is an oil-producing country, petroleum and petrochemistry gained more attention and had more influence than the areas of basic research carried out in IVIC. This was resented by some members of the scientific staff. Large financial resources were needed. These were forthcoming but this caused even more resentment at the power of the petroleum research group within the institute. Because of the difficulty of obtaining access to basic technical information from the foreign-owned oil-producing firms, IVIC's research group tried to establish close links with the national oil and petrochemical industries and with political and military leaders. This reduced the self-containedness of IVIC.

The research programme could in fact be maintained within the Institute's boundaries only during the early stages. When the programme gained momentum after the Oil Nationalisation Decree in 1976, research had to be moved to a new institution—the Instituto Venezolano de Tecnología del Petróleo (INTEVEP), a public foundation directly linked to the nationalised oil firms.⁴⁷ The transfer of IVIC's petroleum and petrochemistry group to INTEVEP was accomplished in less than two years, between 1976 and 1977, although the laboratories in the new setting were not yet ready. About 80 persons left IVIC—research workers, and technical and administrative staff; salaries were substantially higher in INTEVEP. Although initially INTEVEP adopted the form of a public foundation, in 1979 it became an "affiliate" of the national holding company, Petróleos de Venezuela (PDVSA), with the status of a commercial firm.

The lesson was that "nationally relevant" research could be initiated and developed within the framework of an "academic" institution. Very rapidly,

⁴⁷ Vessuri, H., "La investigación química en el IVIC", *op. cit.*

IVIC's small group of chemists working on petrochemistry passed from the obscure periphery, where they had been enclosed in their narrow scientific domain, to a much more central position in Venezuelan society, by directing their scientific interests to specific economic objectives. The attempts of scientists to do economically useful research could be interpreted as highly political, not only in the sense that it was not free of nationalist rhetoric, but because it necessitated the mobilisation of social groups whose economic interests led them to "invest in nationality". In this process, even a "greenhouse" institute like IVIC played a part in the programme which urged that scientific activity be associated with national policies and short-term results.

The Indigenous Training of Scientists

The North American higher educational system had long been represented by various groups of reformers as the most convenient one to emulate and draw upon. During the 1970s, cultural connections with the United States became more intensive in scientific and technological matters. Alongside the old system of autonomous universities, an "experimental university system" arose, encouraged by international technical agencies and by the state planning bodies. Its aim was selection and training the elite of scientific and technological experts outside the existing university system which, it was agreed, had been contaminated by politics and unmanageably large student bodies. In 1969, with the financial assistance of the Interamerican Development Bank, the Universidad Simón Bolívar was created in Caracas with special emphasis on engineering and science. The next year the Universidad Metropolitana came into being, also in Caracas, sponsored by groups of local businessmen with heavy stress on the engineering disciplines.

Yet the national universities were not standing entirely still. The expansion of the sciences also went on in them (Table II). Thus the school of science at the Universidad de los Andes in Mérida began its activities in 1970, the school of sciences began at the Universidad de Carabobo began in Valencia in 1975, and the experimental science faculty of the Universidad del Zulia in the city of Maracaibo was established in the same year (Table III).

After the Universidad Central had taken the lead in founding the first faculty of sciences in the country, and the first groups of graduates appeared, it took five years for the other national universities to begin to develop schools or departments of science. These newer institutions have been very unevenly successful. In general, their consolidation has been difficult. The lack of a scientific tradition in an underdeveloped country, the scarcity of teachers able to do research, and to teach on the basis of their latest and best research, their wide dispersal over the national territory, the multiplicity of functions of the university teacher, and the unfamiliarity of secondary

TABLE II
Number of Students and Graduates of University Schools of Sciences

Year	U.C.V.		U.L.A.		L.U.Z.		U.D.O.		U.S.B.	
	Students	Graduates	Students	Graduates	Students	Graduates	Students	Graduates	Students	Graduates
1960	465	7								
1961	679	38					8	-		
1962	847	31					25	-		
1963	969	25					26	-		
1964	1,234	41					46	9		
1965	1,756	32					54	7		
1966	1,787	46					49	26		
1967	2,424	51	65	-			79	12		
1968	3,497	54	122	-			104	18	130	-
1969	3,385	58	126	-			154	13	114	-
1970	3,381	50	154	-			167	19	104	-
1971	3,339	76	166	-			194	14	234	-
1972	3,521	109	214	8			206	25	198	-
1973	4,318	110	255	3			155	11	71	19
1974	5,765	94	413	20			178	26	75	24
1975	5,480	126	437	28			182	14	384	-
1976	5,529	121	182	29	185	-	263	35	470	36
1977	4,999	167	426	23	215	-	235	14	566	37
1978	5,008	119	477	21	329	-	249	23	637	56
1979	5,200	307	153	24	347	-	240	19	547	84
1980	5,413	292	785	28	296	-	403	35	575	73
1981	5,336	266	1,093	22	253	-				
Total		2,220		206				320		329

U.C.V.: Universidad de Venezuela; U.L.A.: Universidad de los Andes; L.U.Z.: Universidad del Zulia; U.D.O.: Universidad de Oriente; U.S.B.: Universidad Simón Bolívar.

SOURCES: Consejo Nacional de Universidades. Oficina de Planeamiento del Sector Universitario. *Boletines estadísticos*.

TABLE III

University Graduates in Scientific and Technical Fields from 1976 to 1981

Area of Study	1976	1977	1978	1979	1980	1981
Basic sciences (biology, physics, chemistry, mathematics)	176	240	175	340	317	325
Agricultural and marine sciences (agronomy, applied biology, marine biology, veterinary)	479	364	566	616	550	779
Health sciences (medicine, bioanalysis, pharmacy)	1,310	1,464	1,453	1,813	2,058	1,732
Engineering, architecture and technology	2,374	2,569	3,204	3,396	3,629	4,208

SOURCES: Consejo Nacional de Universidades. Oficina de Planeamiento del Sector Universitario. *Boletines estadísticos*.

schoolteachers with experimental science, have all contributed to this uneven result. The science programmes established at the provincial universities were utterly detached from any idea of the practical application of scientific knowledge in economic activities, and in some cases they were also subjected to excessive provincial political influence. Crucial decisions in the planning of the academic and administrative organisation neglected the intellectual merit of research schemes and the ability to carry them through to successful completion. Furthermore, partly because of local feelings, fewer connections than were desirable developed between the provincial universities and other scientific institutions in the country. Sometimes, greater emphasis was placed on signing co-operative agreements with foreign universities than on strengthening links among institutions within the country.

Thus, despite efforts to "indigenise" scientific training, it was still regarded as necessary to send Venezuelan students to foreign universities for training in science and technology. In the 1970s, government programmes were created to provide fellowships and grants for both undergraduate and postgraduate training abroad in the sciences and engineering and in the humanities. At the undergraduate level, these programmes have competed for students with the regular courses at the national universities. The most important fellowship programmes were those of the Consejo de Desarrollo Científico y Humanístico de la Universidad Central (CDCH), started in 1958, of IVIC, beginning around 1960, of CONICIT which began in 1978, of FONINVES which began in 1972, and which has recently been converted into a training programme for the oil industry exclusively, and the programme of the Fundación Gran Mariscal de Ayacucho, beginning in 1974. The majority of scholarship-holders have gone to the United States.⁴⁸

⁴⁸ Díaz, E. and Vessuri, H., *op. cit.*, pp. 18-27.

The Increase and Productivity of Scientific Activity

Although the absolute sum provided for research and development has increased, this sum has not increased proportionately to the gross national income of Venezuela (Table IV). Since 1980, provision for scientific research in Venezuela has deteriorated. Ernesto Palacios Pru, the current president of CONICIT, recently said that science in Venezuela has been

TABLE IV
Comparison of the Budget for Research and Development with the Value of Gross National Product, 1978–80

Year	Budget of Main Public Bodies performing Research and Development	Gross National Product	Gross National Product spent on Research and Development
	(Millions of US Dollars)		(Percentage)
1978	140	39,800	0.35
1979	143	49,000	0.29
1980	174	60,000	0.29

SOURCE: CONICIT, *Ciencia y Tecnología en cifras. Boletín estadístico no. 1* (Caracas: July 1981).

subjected to a “dromedary” policy. CONICIT’s budget, like the hump of the Arabian camel, began with 6 million Bolívares, rose to 93 million, and is now at 73 million; with the currency devaluation, the latter sum will be worth 49 million of pre-devaluation Bolívares, a figure equal to that of the budget of 1976.⁴⁹ Venezuelan scientists were dismayed by the reduction in the funds granted for research by government as part of its effort to cope with the renegotiation of the country’s indebtedness to foreign creditors.

Whatever the uncertainties of Venezuelan science policy, the government’s policies have certainly been successful in increasing the number of scientists and the amount of scientific work done in Venezuela. The “dromedary” policy has produced a larger body of scientists and technologists, not all of whom, however, are engaged in research. The number of research workers has also increased: there was a slight increase in the percentage per 10,000 inhabitants from 2.47 in 1970 to 2.72 in 1977 (Table V). In terms of specialised occupation, these figures show a very uneven development (Table VI).

From 1970 to 1977, the total number of scientists, technologists and research workers increased by 60 per cent; the increase was unequal, those in engineering growing by 129.5 per cent, those in medicine by 82.4 per cent. At the beginning of this eight-year push, there was a predominance of fields of exact and natural sciences, the medical and agricultural sciences. At the end of this period, there was a slight predominance of the medical sciences

⁴⁹ *El Nacional*, 24 August, 1984.

TABLE V
*Number of Scientists, Technologists and Research Workers in Venezuela
 per 10,000 inhabitants, 1970–77*

Year	1970	1973	1975	1977
Number of scientists and technologists	3,340	3,567	3,885	4,046
Number of research workers	2,536	2,809	3,318	3,464
Number of inhabitants (millions)	10.27	11.27	11.99	12.73
Scientists and technologists per 10,000 inhabitants	3.25	3.17	3.24	3.18
Research workers per 10,000 inhabitants	2.47	2.49	2.77	2.72

SOURCE: CONICIT, *Encuestas de Organizaciones de Investigación y Desarrollo*, OCEI. Dirección de Estadísticas y Censos Nacionales, quoted in CONICIT, *Ciencia y tecnología en cifras, Informe estadístico no. 1* (Caracas: July 1981).

with 24.7 per cent of all research workers, then the exact and natural sciences, with 21.5 per cent, the agricultural sciences with 20.4 per cent, and the engineering sciences with 19.7 per cent.

Although the productivity of Venezuelan scientists is lower than that of scientists in industrial countries, this could be attributed to the "smallness of its scientific community rather than to an anomalous low productivity".⁵⁰ Roche and Freitas argue that the figures for the number of papers per research worker per year at IVIC, the Universidad Central and the Universidad Simón Bolívar, are comparable to those of some institutions in scientifically advanced countries. Of 473 research workers at IVIC, the Universidad Central de Venezuela and the Universidad Simón Bolívar, 92.9 per cent of physicians and, 79.3 per cent of natural scientists produced published papers; only 54.9 per cent of agricultural scientists published anything. The index of publication was 1.3 papers per individual per year for IVIC, 0.6 for the Universidad Central and 0.5 for the Universidad Simón Bolívar. These figures may be compared with 0.6 papers per worker per year at Jodrell Bank, 0.75 at certain American research institutions, and 1.9 at certain other institutions in the United States.⁵¹

Practically all the members of the research staff of IVIC published papers; 72 per cent did so at the Universidad Central and 55 per cent at the Universidad Simón Bolívar. The various institutions explain the difference in their productivity by the fact that IVIC is a research institute, whose tradition takes scientific productivity specifically into account for promotion. The universities, on the contrary, are more heterogeneous. Although

⁵⁰ Roche, M. and Freitas, Y., *op. cit.*, pp. 279–290.

⁵¹ Irvine, J. and Martin, B. R., "A Methodology for Assessing Scientific Performance of Research Groups", *Scientia Yugoslavica*, VI (1980), pp. 83–95; Cole, J. R., *Fair Science: Women in the Scientific Community* (New York: The Free Press, 1979); Zuckerman H., *Scientific Elite: Nobel Laureates in the United States* (London: Macmillan, 1977).

TABLE VI
Number of Scientists and Technologists engaged in Research and Development, according to Field of Specialisation

Field of Specialisation	1970		1973		1975		1977		Relative Increment 1970-77
	No.	%	No.	%	No.	%	No.	%	
Exact and natural sciences	649	25.7	1,012	28.4	1,062	27.5	873	21.5	34.5
Technology and medical sciences	549	21.6	634	17.8	803	20.8	1,000	26.7	82.4
Technology, engineering and architecture	346	13.6	493	13.8	673	17.5	794	19.4	129.5
Technology and agricultural sciences	554	21.8	771	21.6	663	17.2	822	20.4	48.4
Social and human sciences	438	17.3	514	14.4	569	14.7	523	12.9	19.4
Others	-	-	143	4	86	2.3	34	0.8	-
Total	2,536	100	3,567	100	3,856	100	4,046	100	60.0

SOURCES: CONICIT, "Encuestas de Organizaciones de Investigación y Desarrollo", quoted in CONICIT, *Ciencia y Tecnología en cifras. Boletín estadístico no. 1* (Caracas: July 1981).

they have highly productive scientists, there are also many teachers who have survived simply by teaching or through their political connections; the latter are counted as scientists or research workers without having done any research. The teaching load in universities is heavy and the number of students large. Although research is provided with formal support in the universities, the performance of research, and publication, are hardly taken into consideration in appointments and promotions in many faculties.

At IVIC, almost all research workers who have published, do so in well-known journals, while at the two universities only a little over one half of those who published the results of research did so in journals of note. There was a marked increase in the number of Venezuelan scientists doing so (Table VII). In absolute terms, the Universidad Central, because of its larger size, has more members of its teaching staff who publish in internationally acknowledged journals than does IVIC. But at the same time, the increase in that mode of publication has increased more at IVIC than at the Universidad.

A Venezuelan scientist knows that if he publishes in a Venezuelan journal he is, with very few exceptions, "burning" his paper, since it will have little chance of entering the international flow of knowledge. There are of course differences from one field to another; in the social sciences, for example, and also to an extent in the agricultural sciences and engineering, there is an increased local or regional readership. Physicists, biologists, chemists, mathematicians and medical scientists are forced by the nature of their disciplines to publish in either English or French—but mainly in English.

One important exception is *Acta Científica Venezolana* which is recognised by Venezuelan scientists as the significant organ of scientific communication. There are about 220 scientific periodicals in Venezuela and their very abundance in such a small country is an indication of their weakness. The mean life-span of 94 Venezuelan medical journals, i.e., the time within which half of the journals disappeared, was two years. Six years after their creation, no more than 20 per cent of the 94 journals remained in existence.⁵²

*The Planning of Science and Technology*⁵³

The years between 1974 and 1976 when the *First National Science and Technology Plan (1976–80)* commissioned by the national government was written, were particularly significant. They were the years when the idea of a

⁵² Arends, T., "Las revistas latinoamericanas: Diagnóstico de la situación y proposiciones para mejorarlas", *Investigación Clínica*, XVII (1976), pp. 1–17, quoted in Roche, M. and Freites, Y., *op. cit.*, p. 287.

⁵³ See Antonorski, M. and Avalos, I., *op. cit.*, pp. 93–16, particularly with regard to the consideration of the First Science and Technology Plan; in connection with the Second Science and Technology Plan, see Rengifo, R., "Ciencia y política en Venezuela: del espejismo al simulacro", paper presented in the symposium "Política científico-tecnológica en América Latina", in Guanajuato, November 1982, under the auspices of UNAM, CESTEEM, and UAM.

TABLE VII
*Number of Venezuelan Authors of Scientific Publications Internationally Acknowledged,
 Classified by Institution, 1970-79*

Institutions	1971	1973	1975	1977	1979	Relative Increase 1971-79 (percentage)
IVIC	79	60	55	91	175	121
Universidad Central	126	69	94	55	190	51
Universidad de los Andes	14	16	19	23	79	467
Universidad del Zulia	23	6	14	13	17	152
Universidad Simón Bolívar	-	-	6	12	58	-
Universidad de Oriente	31	26	29	16	55	77
Universidad de Carabobo	17	4	6	3	25	47
Other institutions	31	26	29	70	86	177
Total	321	207	252	283	685	

SOURCES: CONICIT, *Ciencia y tecnología en cifras. Informe estadístico no. 1* (July 1981), based on Institute for Scientific Information, *Who is Publishing in Science* (Philadelphia: 151, 1971-75), and *Current Bibliographic Directory of the Arts and Sciences* (Philadelphia: 151, 1977-79).

world divided into a rich North and a poor South was being promulgated. Spokesmen for the poor countries were putting forward a common demand for the industrial countries to modify their strategy for a new international economic order based on redeployment of certain industries, which were not the most appropriate ones to foster development.⁵⁴

There was also much discussion in Latin America of regional integration. From the beginning of the 1970s, efforts at regional integration acquired new strength with the conclusion of the Andean Pact. The junta of the Acuerdo de Cartagena—the agreement signed initially in 1969 by Bolivia, Chile, Colombia, Ecuador and Peru, and later by Venezuela which established the Andean Pact—made three important decisions which bore on technology policy. These were No. 24 on the regulation of foreign capital and transfer of technology; No. 84, which set the basis for a sub-regional technology policy; and No. 85, which set forth new regulations with regard to industrial property. These and other measures pointed to the delineation of certain “areas of technological integration” where joint actions and programmes appeared possible and desirable.⁵⁵

The fourfold increase in the price of oil in 1973 brought with it unprecedented wealth for Venezuela. A number of basic industries were taken into public ownership, and outside the sector of nationalised industry, the government increased considerably its intervention in the economic life of the country. A programme of industrialisation in the form of the manufacture of consumers and capital goods was set in motion.

CONICIT elaborated the First Science and Technology Plan to be carried out over the period from 1976 to 1980. The Plan accepted the views current at the time with regard to the marginal role which scientific and technological development had hitherto played in Venezuela and anticipated a greater role for these activities in the future.⁵⁶ The Plan suffered from the limitations of the existing information about Venezuelan conditions and it ignored the conflicting interests at play. It presented a long list of objectives without any of the resources necessary to carry them out.

The Plan was incapable of realisation. It subordinated improvement of the capacities of the country in science and technology to economic growth. Although the economic objectives set out in the Fifth National Plan were adopted by the First Science and Technology Plan, it was done inadequately and there was no articulation of the economic and the technological goals. The First Plan was in fact contradicted by the demands of the chosen national strategy of economic growth. In the last resort, it served as an

⁵⁴ Ernst, D., “Industrial Redeployment and International Transfer of Technology: Trends and Policy Issues”, *Vierteljahresberichte*, LXXXI (March 1981), p. 123.

⁵⁵ Sagasti, F., “Integración económica y política tecnológica: el caso del Pacto Andino”, *Comercio Exterior*, XXV (January 1975) pp. 46–49; Soto-Krebs, L., “Tecnología en el Grupo Andino”, *Comercio Exterior*, XXV (January 1975), pp. 50–57.

⁵⁶ Gasparini, O., *La investigación en Venezuela: condiciones para su desarrollo* (Caracas: IVIC, 1969) presented the notion of marginality of science and technology in Venezuela, which became a standard conceptual frame of reference in Venezuelan discussions.

intellectual legitimization of the political ambitions of the political and economic elite of the country, which declared itself committed to "industrial redeployment", to the nationalisation of some basic industries, to state capitalism and industrial growth.

The information available at the time of the First Plan was mostly about the "national research potential", which adhered to the categories and definitions supplied by UNESCO. Little attention was paid to the actual state of Venezuelan research and development, to its marginality and its relations with science outside Venezuela.⁵⁷

Two senior critics of the Plan, Antonorsi and Avalos, have analysed what they considered the basic ideas on which it was founded. They have charged it with being too abstract, too doctrinaire in its acceptance of idealised planning methodology dictated by the systems-approach so widespread in Latin America at that time.⁵⁸ It proceeded, they said, as if there were no human beings or particularistic interests.⁵⁹ It disregarded questions about the quality and the supply of Venezuelan scientists and technologists.

They also criticised the assumption of a linear model, according to which innovation begins in the laboratory with a basic scientific discovery and ends in the practical form of technology, passing through the orderly sequence of applied research, experimental development and commercial application. In their view, this simplistic view of innovation did not help in the understanding of problems of technology in a country like Venezuela, and it hindered the search for better policies. The critics accepted the importation of foreign technology, but they thought that the imported technology should serve to improve the technological capacities of the industrial firms of underdeveloped countries. In their view, foreign technology and the local generation of technology, which—in the current conception—are contradictory, need not be so but rather could complement each other.

Through the local adaptation of imported technology, and the introduction of "minor" innovations in a country like Venezuela, the purchasing firm, and ultimately the country as a whole, would not only obtain machinery, equipment and procedures, but also the knowledge, skills and experience that contribute to building a body of technological knowledge,

⁵⁷ In 1965, a preparatory committee for the creation of the national council of scientific and technological research published *La ciencia: Base de nuestro progreso* (Caracas: Ediciones IVIC, 1965), which presented the earliest statistical analysis of the national scientific potential and a historical review of the evolution of several scientific disciplines in Venezuela until 1940. Other classic works from this period are Olga Gasparini's *La investigación en Venezuela (Condiciones para su desarrollo)*, (Caracas: 1969), published at the time CONICIT was beginning to function, and the collective work of a team which the department of sociology and statistics of CONICIT published under the direction of Dulce de Uzcátequi, *Diagnóstico de la actividad de investigación y desarrollo experimental que se realiza en el país* (Caracas: CONICIT, 1973).

⁵⁸ Sagasti, F., *Hacia un enfoque para la planificación científica y tecnológica*. (Washington, DC: OEA Departamento de Asuntos Científicos 1972); Amadeo, E., "Los Consejos nacionales de investigación en América Latina: Exitos y fracasos del primer decenio". *Comercio Exterior*, XXVIII (December 1978), pp. 1,439–1,447.

⁵⁹ Antonorsi, M. and Avalos, I., *op. cit.*, pp. 94–95.

and the culture of technology which would enable the country to begin to create some of the technology it needs.

The knowledge and skills needed for the development of technology in a country like Venezuela are different from basic scientific knowledge. However, the only intellectual notions with which local planners were familiar at the time were those of "science planning" in the style recommended by UNESCO. They were therefore unable to recognise that technological development has a certain immanent tendency, an autonomous potentiality of growth from within, just like the autonomy of scientific knowledge. The local planners failed to understand that technological development is not simply an epiphenomenal function of the development of basic science. They did not see that although technology, especially in the contemporary situation, is very much affected by scientific progress, and is indeed in many ways dependent on it, the promotion of basic science is not a guarantee of technological development.

Despite their statements to the contrary, the authors of the First Plan believed that there was automatic and commensurate connection between science—and technology—on the one hand and economic growth on the other; that was why the strategy of the Plan was concentrated on the development of science. They subscribed to the unrealistic recipe: "more science to overcome underdevelopment."⁶⁰

The Plan accepted as a postulate that science and technology can be developed in a country through a deliberate effort by the government. This assumed a need for centralised control over science for development. In any case, CONICIT, even with the change in its legal status proposed at various times, would be an inadequate institution to serve as the co-ordinating and planning body of the national institutional system of science and technology. Its internal organisation made it quite efficient for the promotion and the support of scientific activities, but not for the comprehensive management of all of science and technology.

In fact, as Antonorsi and Avalos pointed out, scientific and technological development in Venezuela, such as it is, has been decentralised, non-interventionist, and open. The universities, which contain 60 per cent of the scientists presumably capable of doing research, have not been controlled by the requirements of the First Plan. IVIC too has always defined its own programmes, the only limitations being imposed by its own internally-set objectives and traditions and the available resources. In effect, the three fundamental objectives of the Plan—to improve Venezuelan scientific and technological work, to link it with national requirements, and to control and absorb imported technology—remained an almost empty declaration. The Plan stated that the problems were "profound" but it itself was superficial in most of the actions its proposed.⁶¹

At the beginning of 1978, work was started in the planning directorate of

⁶⁰ *Ibid.*, pp. 95–99.

⁶¹ *Ibid.*, p. 109.

CONICIT on a Second Science and Technology Plan. This new plan would, it said, take advantage of the experience accumulated since the previous one, particularly because an elaborate critical discussion had been aroused—so it was argued—and because the Plan had now greater political support. But none of these assertions had any substance. In fact there was very little accumulation of experience within CONICIT since between 1976 and 1978 there was a turn-over of two thirds of the entire staff of some 300 persons. Furthermore, there was little serious “public debate”; the participants in the “debate” were relatively few; it was not really a debate but rather what Rengifo has defined as a “usual artifice in public administration by which guilt is exorcised through a simulacrum of public debate”.⁶² Furthermore, government was not really interested in the Plan although at first it gave it formal support.

So, despite enormous exertion, the Second Plan fell into the same basic mistakes as the earlier one; it argued for centralised policy but it, again, had no support from the government or Venezuelan society. Once the document was submitted to the Minister for Science and Technology, the Plan was reduced and the only new part, its emphasis on projects already agreed in specific sectors, was suppressed. It was really a contrived amalgamation with the First Plan. The government disregarded the Second Plan and never gave it legislative force. After the resignation of the planning director of CONICIT and the demise of the Second Plan, the new director tried to put in to practice some of the views articulated in a book of criticism of the First Plan of which he had been a co-author. He rejected the very idea of a plan and favoured the elaboration of concrete programmes linked to specific sectors of activity, as well as the need for CONICIT to give support to projects already established as a result either of the initiative of industry, the scientists themselves or government; he also recommended the transformation of the planning directorate of CONICIT into a research unit.⁶³

The planners who were responsible for the two plans simply presumed that the situation was ripe and that a technology policy was an objective necessity. They omitted any consideration of the “producers” who should have been the direct and natural executants of the Plan, nor did they attempt to obtain political support for it. The scientists wanted to continue to function without external interference in their own areas and were reluctant to accept a centralised plan.

Concluding Remarks

After about 30 years of effort, a small scientific community has emerged in Venezuela. The central features of a scientific community are present: there exists a considerable number of scientists actually engaged in research and in

⁶² Rengifo, R., “Notas sobre el Segundo Plan de Ciencia y Tecnología” mimeo, Caracas, CENDES, 1984.

⁶³ *Ibid.*

close contact with each other and with mutual respect for each other's achievements. They have a sense of solidarity and identity through awareness of their common belief in standards of scientific procedures and of scientific integrity. There is quite a number of persons seriously engaged in research according to relatively high standards which they apply to themselves and to each other. The critical reviews by local referees of papers submitted to *Acta Científica Venezolana*, for example, are considered for certain disciplines to be harsher than those of many international journals, because of their zealousness on behalf of the standards which they fear are threatened by their peripheral situation.

The Venezuelan scientific community is like all scientific communities, built in a hierarchical form. Its leaders—persons like De Venanzi, Roche, Villegas, Layrisse, Carbonell, Pifano and Convit—have applied serious standards in their own work and in their judgement of the work of their Venezuelan fellow-scientists; they have led the course of scientific activity in the country through their solicitous yet critical custodianship of the institutions which foster and support research. Indeed the prestige and power of these persons as a group and as individuals has been such in the last 30 years that the intermediate generation of scientific leaders has been somewhat overshadowed and inhibited by them. Currently, a much younger group of scientists is being supported by the older leaders and they appear to be likely heirs of the scientific community. Among this younger group, now in their thirties and early forties, are persons like Carlos Di Prisco, a logician, Miguel Octavio, a physicist, Heinz Krentzien, a chemist, and Luis Avila Bello, a physician—the winners of the Fundación Polar prize which was awarded last year for the first time. The academic judges for this competition were the older leaders of the national scientific community; they said they were giving the prize to young persons of great scientific promise.

As in every scientific community, there is a certain amount of consensus among the leading Venezuelan scientists about standards in general and substantive judgements about particular accomplishments. This is expressed, for example, in the work of the advisory technical committees of CONICIT. These committees are formed by active scientists of the appropriate disciplines; their task is to assess the quality of new proposals and progress and achievements of projects already supported by CONICIT. Such committees also exist for assessing the quality of candidates for the fellowships offered by CONICIT, the requests for grants to institutions for postgraduate programmes, and laboratory equipment for specific research projects or programmes. Of course there are disagreements and, in this particular case, as concerns CONICIT, its judgements do not always elicit agreements. Nonetheless through the years this government agency has exemplified and diffused to the academic community at large, reasonable ways of doing and evaluating research.

Why then, it may be asked, if a Venezuelan scientific community has come into existence, should there be such feelings of disappointment and

frustration on the part of many Venezuelan scientists, and so much criticism of science and scientific accomplishments by intellectuals who are not scientists? The following should be said: The creators of the Venezuelan scientific community, i.e., those who succeeded in imprinting serious standards among Venezuelan scientists, generating devotion to the pursuit of scientific knowledge and obtaining the support and tolerance of government, thought that the development of a scientific community would automatically bring about technological achievements and economic growth. The difficulty which the scientific community has experienced in attempting to articulate itself with the technology of industrial and agricultural production has instead led to disappointment among many scientists.

But this was not merely a mistake of Venezuelan scientists and the patrons and makers of science policy. It has been a belief widely held by publicists and promoters in the field of science policy; it is however an erroneous or at least inadequate belief. The inadequacy of the view is particularly disaffecting in underdeveloped countries. The notion that modern technology is ultimately based on science led to a stereotyped and simplistic conception of a sequence, in which technological innovations are the result of a process beginning in the knowledge produced by basic research and ending in the marketing studies which facilitate the economic application of that knowledge. Despite criticisms, this notion is still very much used by international organisations which take on themselves the formulation of recommendations for developing countries.

In fact, the conception of reality postulated by this view is very far from what countries like Venezuela have to face. Such countries use technology acquired abroad. In consequence, the growth and well-being of a scientific community, generally recommended as a necessary precondition for technological and economic development does not necessarily—usually it does not—bring about a corresponding technological achievement, any more than the existence of a technological achievement necessarily entails its economic application in industrial or agricultural production.⁶⁴

In countries like Venezuela, in which the technology of economic production is acquired abroad through the transfer of technology, the distinction between scientific achievement and technological achievement is important. It is true that it would be very difficult to develop a technology—particularly in certain fields—without a scientific foundation. But the one is not the cause of the other as has often been assumed by writers and institutions who, for a quarter of a century after the Second World War, made it appear that there was a direct connection between expenditure in research and development and economic growth.

This erroneous conception of how technological innovations come about

⁶⁴ Avalos, I. and Viana, H., "Bases para la elaboración de indicadores de medición de la capacidad tecnológica". Project "Prospectiva Tecnológica en América Latina", UNU-IDRC, mimeo., Caracas, CENDES, 1984.

and of the link between science and technology in poor countries has resulted in overburdening the scientific community of these countries with demands which cannot possibly be satisfied by competent and even excellent scientific research. The governmental and private patrons of science, and above all politicians, publicists and intellectuals already unsympathetic to science, charge the scientific community with indifference to the well-being of their fellow-countrymen. Scientists too with nationalistic and sometimes radical political outlooks express discontent with scientific research which does not make their countries prosperous, "really independent", just and powerful.

Frustration is sharper today, at a time when the financial crisis of a country like Venezuela places a strain on the budgets of scientific institutions and the government's scientific programme. The scientific activity of a country like Venezuela depends on imported equipment and literature which, with currency devaluation, become more difficult to obtain. This economic strain seriously endangers the structure and ethos which it has taken over 30 years to implant. Not only sophisticated instruments but also complementary equipment such as refrigerators, trolleys, glass of all shapes and kinds, chemical substances, even the pigeons and rats needed in experiments, have been imported in the past and are now practically impossible to obtain because of the shortage of foreign currencies. Thanks to the influx of wealth in the recent past resulting from the revenues from oil, Venezuela had managed to acquire adequate laboratories and equipment; scientists could travel frequently enough to attend scientific meetings in foreign countries, present papers, learn about the latest developments in their fields of specialisation and obtain fresh bibliographic references. All these things have been drastically handicapped since February 1983.

A possible advantage of this blow to science is that it might force the members of the scientific community of Venezuela to develop closer links with each other within the country; it might induce individual scientists and research groups to create a greater number of local fora for scientific discussion, and more programmes of postgraduate training to take advantage of existing expertise within the country; it might encourage a more efficient use of the opportunities for international communication which are still available in the form of visiting professorships and books and journals for libraries.

Venezuelan society has been demanding the wrong things from the scientific community, and it has done so mainly because the scientific community was convinced that it could do them and has permitted society to believe the same. The current critical situation seems a good opportunity for this scientific community on the periphery of the world scientific community to think once more about what it can do by itself as part of the world scientific community, although at its periphery, and what is probably beyond its powers.