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PIONEERS AND VICTIMS: THE BIRTH AND DEATH OF ARGENTINA'S FIRST MOLECULAR BIOLOGY LABORATORY

ABSTRACT. The first Latin American molecular biology laboratory came onto the scientific scene in Argentina in early 1957, only to be dismantled in 1962, following a ministerial change. This paper explores the social, political, institutional, and cognitive interactions present in this short experience, and assesses their importance in understanding the development of a new scientific field in a 'peripheral context'.

INTRODUCTION

In 1957, the first molecular biology laboratory in Argentina was established in the Dr. Carlos Malbrán National Institute of Microbiology (*Instituto Nacional de Microbiología Dr. Carlos Malbrán*). It was headed by Cesar Milstein, a young chemist who won the Nobel Prize in 1983 for his work on monoclonal antibodies at the MRC Laboratory in Cambridge. Five years later, following a decision by the Ministry of Public Health (*Ministerio de Salud Pública*), the laboratory was dismantled, and most of its researchers emigrated or moved to other fields. There is an important question – why was a molecular biology laboratory set up in the late 1950s, in a peripheral context, at a moment that could be described as being 'early' in the development of molecular biology as a scientific discipline?[1] To answer this question, and to explore its wider significance, requires a close

[1] There are many studies of the origins of molecular biology, including Pnina Abir-Am, *Research Schools of Molecular Biology in the United States, United Kingdom, and France: National Traditions or Transnational Strategies of Innovation?* (Berkeley: University of California Press, 2000); Jean-Paul Gaudillière, 'Molecular Biology in the French Tradition? Redefining Local Traditions and Disciplinary Patterns', *Journal of the History of Biology*, 26 (3), (1993), 473–498; Angela Creager, 'Sequences, Conformation, Information: Biochemists and Molecular Biologists in the 1950s', *Journal of the History of Biology*, 26 (3), (1993), 331–360; and Lily E. Kay, *The Molecular Vision of Life: Caltech, the Rockefeller Foundation and the New Biology* (New York: Oxford University Press, 1993). We have also found useful: Robert Olby, *The Path to the Double Helix: The Discovery of DNA* (New York: Dover, 1994); Michel Morange, *Histoire de la biologie moléculaire* (Paris: La Découverte, 1994); and Nicholas C. Mullins, 'The Development of a Scientific Speciality: The Phage Group and the Origins of Molecular Biology', *Minerva*, 10 (1), (1972), 51–81.

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examination of what, for Argentina, was a brief but instructive experience. For the scientists involved, it was not yet clear that the techniques issuing from molecular biology were laying the foundations of a new discipline. On the contrary, many accepted the new research techniques without realising that the investigational logic of the life sciences was being called into question. This point has its correlate on the international stage, where the term 'molecular biology' was not perceived as denoting any specifically-defined field of knowledge.[2]

This paper examines a case of scientific practice in a 'peripheral' context, and its relationship with so-called 'central' scientific traditions. In general, scholarship in 'science studies' has accepted the particular way in which modern science represents itself as 'universal'.[3] Yet, over the past three decades, the interpretation of scientific practices has been increasingly linked to the contexts in which such practices originate and develop. Practices are generally formulated at the micro-level of work spaces, including 'laboratory cultures and local traditions rather than national context ... institutional settings, schools and informal networks'.[4] They are also shaped by local traditions, as they form networks involving different generations, collective spaces, and genuine 'transepistemic arenas' where the interplay between local actors is particularly important.

The setting-up of a molecular biology laboratory in Argentina can be viewed as a precedent for the construction of a new field of knowledge and social practice. Its history involves not only 'disciplinary innovation', but also factors that shaped the development of molecular biology in Argentina, and its relationship with the international scientific community. A particular feature of 'peripheral' science we have described as 'subordin-

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[2] As André Lwoff's pointed out in 1966: '... as the prophage is a molecule (of nucleic acid) and as I was studying its biology, I later became a molecular biologist. A fearful position, although around 1950 *would-be molecular biologists did not think of themselves like that*. The immeasurable virtue of the magic label was only discovered much later on. Perhaps I ought to add *that I am incapable of deciding to what extent I feel molecular, if indeed I am molecular at all*'. See 'The Prophage and I', in John Cairns, Gunther Stent and James Watson (eds.), *Phage and the Origins of Molecular Biology* (New York: Cold Spring Harbor Laboratory of Quantitative Biology, 1966), 88–99. The issue of equipment is particularly salient in that technical innovation has played a crucial role in the conceptual development of molecular biology. See Jean-Paul Gaudillière, 'Molecular Biologists, Biochemists, and Messenger RNA: The Birth of a Scientific Network', *Journal of the History of Biology*, 29 (3), (1996), 417–445; and Lily Kay, 'The Tools of the Discipline: Biochemists and Molecular Biologists', *Journal of the History of Biology*, 29 (3), (1996), 446–447.

[3] See Roy MacLeod, 'Introduction', in Roy MacLeod (ed.), *Nature and Empire: Science and the Colonial Enterprise, Osiris*, Second Series, 15 (2000), 1–22.

[4] Gaudillière, *op. cit.* note 1.

ated integration'.[5] This concept involves a kind of 'international division of labour', in which successful researchers at the 'periphery' are integrated into international networks, often by accepting a subordinate role.[6] The circumstances surrounding the establishment, development, and 'death' of the laboratory at the Malbrán Institute have led us to ask why the 'immediate' diffusion of molecular biology did not take place; and why it was not until the early 1970s that groups in this area were finally consolidated. In the event, this occurred under the auspices of the Campomar Foundation (*Fundación Campomar*), after more than a decade of 'latency'.[7]

It is usual, when periodizing the history of science in Argentina, to establish a relationship between military intervention, scientific emigration, and institutional instability. The irruption of politics into the realm of science has been a defining factor in Argentina, as it has in other Latin American countries (and other developing countries), and an understanding of the years 1943, 1966 (the year of the Onganía dictatorship's violent intervention in the University of Buenos Aires, known as the 'night of the long sticks'), and 1976, is vital to our understanding of the dynamics of science in this country. Even so, the history of science cannot be seen entirely in terms of politico-military interventions. Rather, it is necessary to establish elements arising within both the socio-institutional context and local scientific practice. Thus, while 'external' interventions necessarily emphasize ruptures, a more comprehensive history has to explain both ruptures and continuities.

In the first part of this paper, we describe the 'traditional' institutional context in which molecular biology laboratories have been set up, focusing upon the Malbrán National Institute of Bacteriology during the post-Peronist period (1956–1962). In the second part, we describe

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[5] For a fuller explanation, see Pablo Kreimer, 'Understanding Scientific Research on the Periphery: Towards a New Sociological Approach?', *EASST Review*, 17 (4), (1998), 13–21.

[6] Although the concept of 'subordinated integration' has not yet been developed empirically, various authors have tackled similar ideas. See Hebe Vessuri, 'Scientific Cooperation among Unequal Partners: The Strait-Jacket of the Human Resource Base', in Roland Waast (ed.), *Les Sciences hors d'Occident au XX Siècle, Vol. 7: Coopérations Scientifiques Internationales* (Paris: ORSTOM, 1996), 171–186; Hebe Vessuri (ed.), *La ciencia periférica* (Caracas: Monte Avila, 1983); Pablo Kreimer, 'Fazer Ciencia na periferia: entre a excelencia e a marginalidade', in *Ciencia e tecnología para o século XXI* (Porto Alegre: SCT-RGS, 1999), 120–138; and Marcos Cueto, *Missionaries of Science: The Rockefeller Foundation and Latin America* (Bloomington and Indianapolis: Indiana University Press, 1994).

[7] For a 'parallel' analysis of this process in Spain, see María Jesús Santesmases and Emilio Muñoz, *Establecimiento de la bioquímica y de la biología molecular en España (1940–1970)*, (Madrid: Fundación Ramón Areces, Consejo Superior de Investigaciones Científicas, 1997).

the state of research in molecular biology in the 1950s, and outline its meanings among local and international scientific communities. Lastly, we draw some conclusions about a process whose full meaning is most clearly appreciated when the vacuum that has characterized research on this subject is seen for what it is.

Context and Institutions

Political and cultural modernization in Argentina

Beginning in the mid-1950s, Argentina underwent a process of modernization and institution-building. This was accompanied by a convergence between research and science policy. Generally speaking, this innovation was characterized by a steady transformation of older institutions and the creation of several new ones. Among the newer institutions were four institutes which, along with the national universities, formed the backbone of the Argentinean 'Scientific and Technological Complex'. (See Table I.)

TABLE I

The Institutional System of Science, Technology and Innovation in Argentina in the late 1950s

Performance level	Basic and applied sciences	Agricultural research	Industrial technology	Nuclear research and production
Policy-making	CONICET			CNEA
Promotion	CONICET	INTA	INTI	CNEA
Execution	National Universities Malbrán Institute Hospitals CONICET	INTA National Universities		

Abbreviations: CONICET: *Consejo Nacional de Investigaciones Científicas y Técnicas* (National Scientific and Technical Research Council, set up in 1958); CNEA: *Comisión Nacional de Energía Atómica* (National Atomic Energy Commission, set up in 1955); INTA: *Instituto Nacional de Tecnología Agropecuaria* (National Institute of Agricultural Technology, set up in 1956); INTI: *Instituto Nacional de Tecnología Industrial* (National Institute of Industrial Technology, set up in 1957). For an analysis of institutional change in Argentinian S&T policy, see Pablo Kreimer, 'Science and Politics in Latin America: The Old and the New Context in Argentina', *Science, Technology and Society*, I (2), (1996), 267–289; Enrique Oteiza, *La política de investigación científica y tecnológica en Argentina. Historia y perspectivas* (Buenos Aires: CEAL, 1992); José Nun, 'Argentina: el estado y las actividades científicas y tecnológicas', *REDES*, 2 (3), (1995), 59–98; and F. Sagasti and M. Guerrero, *El desarrollo científico y tecnológico de América Latina* (Buenos Aires: BID-INTAL, 1974).

The institutionalization of science policy-making was influenced by several concurrent features, including (a) a post-Peronist revival in the universities; (b) the wider application of development models emphasising the role of science in economic planning; (c) the influence of the Economic Commission for Latin America and the Caribbean (ECLAC), and its theories of economic development by import substitution; (d) the institutionalization of science and technology policy overseas, especially in France; and (e) an increasingly active set of international agencies, notably UNESCO and the OAS.[8]

Among the new institutions in Argentina, the most important was the National Scientific and Technical Research Council (CONICET), set up in 1958 to 'promote, coordinate and steer research in the fields of the pure and applied sciences and technologies'.[9] Its model was the CNRS in France.[10] The prevailing idea was that a *system* of science and technology would integrate disparate elements and take 'the mobilization of scientific and technological knowledge for development' as its overall goal. In Argentina, this process was led by Bernardo Houssay, CONICET's founder and first president. Houssay, a physiologist who won the Nobel Prize in 1947, had a good reputation within the local scientific community and with the political leadership. CONICET never wielded the function of 'policy design and planning' assigned at its inception. However, it did make extremely vigorous efforts at promotion, through the award of grants and scholarships, subsidies for research groups, and the creation of a 'status system' (similar to that of the CNRS), which guaranteed career stability. Eventually, CONICET set up institutes of its own, but this practice was marginal until Houssay's death in 1971.[11]

After Peron's fall, the year 1957 saw the beginnings of reform at the University of Buenos Aires. This was a time when many researchers, who had been sidelined (or expelled outright during the Peronist

[8] Pablo Kreimer, 'Science and Politics in Latin America: The Old and the New Context in Argentina', *Science, Technology and Society*, 1 (2), (1996), 273–275.

[9] Decree Law No. 1291/58.

[10] UNESCO's policy was to set up National Science Boards in developing countries. This was particularly true of Latin America, where these types of organizations were set up (beginning with the CNPQ in Brazil) between the mid-1950s and the mid-1960s. For a comparative look at this process, see Eduardo Amadeo, 'Consejos Nacionales de Ciencia y Tecnología en América Latina: Exitos y fracasos del primer decenio', *Comercio Exterior*, 28 (12), (1978), 1439–1447. See also Brawerman and Novick, *Los organismos centrales de Planificación científica y tecnológica en América Latina* (Washington, DC: OEA, 1982); and Manuel Marí, *Evolución de las concepciones de política y planificación de ciencia y tecnología* (Washington, DC: OEA, 1982).

[11] National Secretariat of Science and Technology (Secretaría de Ciencia y Técnica de la Nación), Argentine Republic, *Memoria crítica de una gestión* (Buenos Aires: 1989), 29–36.

period), returned home, including Houssay and Leloir.[12] University reform involved modifying teaching methods and introducing practical work at the expense of lecturing. Syllabi were made more flexible, and faculties were replenished with new full-time posts. Teaching reforms were accompanied by new research institutes, such as the Calculation Institute (*Instituto del Cálculo*) in the School of Exact Sciences. New schools in pharmacy and biochemistry were also created, as were new degrees in psychology and sociology.[13]

Although the State allotted resources and regulated institutional activities, there was no structured or clear-sighted plan in this development. Still, the idea that science and universities could play a central role in socio-economic improvement gathered force. It was presumed that, when research reached 'critical mass', it would produce 'lift-off', with direct benefits for Argentina. The ideologues of this movement were the leaders of the 'academic and scientific communities'.[14] Institutions such as CONICET and the universities were structured according to a view that held that scientific activity was superior to 'second order' activities, such as establishing links with the secondary industrial sector.

The creation of an institutional context for experimental research in the biomedical disciplines was inevitably linked to this tradition. In the process, it called upon external recognition. This was essential to research, but inevitably involved a tension between predominant trends in 'international science', local socio-institutional conditions, and the needs of local users.[15]

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[12] Houssay had founded, in 1943, the Institute of Experimental Biology and Medicine (IBIME) with private, international backing, outside the University. In 1947, with the support of Jaime Campomar, Luis Leloir founded the Institute for Biochemical Research at the Campomar Foundation. Both institutes were key in the development of biomedicine, and kept their private status, although later they were given dual 'public-private' status and made dependent upon CONICET. See Alfonso Buch, *Forma y función de un sujeto moderno. Bernardo Houssay y la fisiología Argentina* (Madrid: Universidad Autonóma de Madrid, 2001); Marcelino Cereijido, *La nuca de Houssay. La ciencia argentina entre Billiken y el exilio* (Argentina: Fondo de Cultura Económica, 1990); *The Memoirs of the Campomar Foundation* (1947–1984); and César Lorenzano, *Por los caminos de Leloir. Estructura y desarrollo de una investigación Nobel* (Buenos Aires: Editorial Biblos, 1994).

[13] See, for example, Tulio Halperin Donghi, *Historia de la Universidad de Buenos Aires* (Buenos Aires: EUDEBA, 1962); and Silvia Sigal, *Intelectuales y poder en la década del sesenta* (Buenos Aires: Puntosur Editores, 1991).

[14] Hebe Vessuri, 'La ciencia académica en América Latina en el siglo XX', *REDES*, 1 (2), (1994), 61–62.

[15] This issue has been discussed particularly in answer to 'diffusionist' models of science. See A. Lafuente and J. Sala, *Ciencia colonial en América* (Madrid: Alianza, 1992); and Juan-José Saldaña, 'Acerca de la historia de la ciencia nacional', *Cuadernos de Quipu*, (4), (1992), 9–54. Patrick Petitjean states that 'in the establishment of scientific

During the late 1950s, there were two differing positions regarding the role of scientists.[16] On one side, Houssay represented a 'traditional' view of science, performed with cheap instruments often made by researchers themselves (the '*bricoleur* scientist'). For Houssay, resources were to be allocated on the basis of individual requests and always in 'reasonable' amounts. On the other side, there were researchers linked to UBA's Science School, led by its dean, Rolando García, who took a more modern view: they had seen the changes generated by 'big science', and propounded the need for greater resources, organized around planned activities with long-term goals. For Houssay, this position amounted to 'setting up a Soviet system'.[17] Broadly speaking, it was Houssay's position – described as '*cientificista*' ('scientificist') by his adversaries – that eventually won the day. Houssay believed that 'although he had always been in favour of research carried out in universities, they were at the time arenas for political debate where decisions were taken by vote and usually swayed by trade union pressure and shady political dealings, any monies allotted to researchers by institutions such as the CONICET being swallowed up by university budgets, and universities generally making the most of this foreign backing to stop supporting science with their respective funds'. Houssay recalls that 'extramural institutes were oases where, when times were hard, many scientists repopulating the universities [he himself was a case in point] took refuge'.[18]

traditions ... 'modernization' has not always been synonymous with 'Westernization', and the development of local dynamics, despite the influence of imperial domination, has depended largely on the ability of the local élites to draw this distinction.' P. Petitjean, 'Introduction', in Roland Waast (ed.), *Les Sciences hors d'Occident au XX siècle, Vol 2: Les Sciences Coloniales, Figures et Institutions* (Paris: ORSTOM, 1996), 7–11.

[16] Houssay was the President, and most members of the Board of Directors were scientists with close links (many of them were his disciples) such as Leloir, Braun Menéndez, De Robertis, and Deulofeu. Pirosky was one of the few who, belonging to the biomedical field, had aligned with García. See CONICET, Minutes of the Board of Directors Meetings, 1960.

[17] For details of this discussion, see Marcelino Cereijido, *op. cit.* note 12, 93. See also Oscar Varsavsky, *Ciencia, política y cientificismo* (Buenos Aires: Centro Editor de América Latina, 1969).

[18] Cereijido, *op. cit.* note 12, 96. This led to an odd situation (similar to the French system), in which there were researchers paid by CONICET who worked in CONICET laboratories, and scientists paid by CONICET who worked in university laboratories, as well as 'pure' university researchers. CONICET researchers working at a university may or may not have had teaching responsibilities, but if they limited themselves to research, their salaries were paid entirely by CONICET. Those who did research and taught received part of their salaries from the university and part from CONICET.

The institutional space of the Malbrán National Institute of Microbiology

Within this broad process of institutional renovation, the Carlos Malbrán Institute, created in 1916, was re-organized in 1957 as the National Institute of Microbiology (*Instituto Nacional de Microbiología*).[19] At its inception, the Institute aimed, first, to produce sera and vaccines, with a view to making Argentina self-sufficient in these products; second, to keep tabs on glandular extracts sold to the pharmaceutical market; and third, to monitor, control and study epidemics and diseases (including the drawing of an epidemiological map). Such 'technical' tasks were combined with research, which began to appear in a journal published by the Institute.[20] In the early days, there was a gulf between 'pure' research, and the applied development of diagnoses and serum and vaccine production. This gulf began to widen as the Institute's different specializations became more professional.

It is interesting to compare the Malbrán with the Oswaldo Cruz Institute in Brazil, since both were modelled on the Pasteur Institute in Paris. As Nancy Stepan has observed, Cruz 'expressed dissatisfaction with the Institute's restricted function as a supplier of vaccines and serums. From his training at the Pasteur Institute, Cruz acquired a working knowledge of the way one of the most scientific institutions in the world was organized'.[21] However, as Stepan points out, the development of the institution in Brazil should not be seen as a mere 'copy'; the 'transfer' process turned out to be far more complex. Significantly, in Brazil there was no trained cadre of bacteriologists to serve the dual function of basic and applied research.

The 'Pasteur' was special in the multiplicity of functions it embraced – the diversification of its 'basic' laboratories, the production of biological material, epidemiological control and vigilance (*veille*), a hospital, and

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[19] The Institute's origins date from 1904. These involve the transformation of a group of laboratories in Argentina's Office of Public Sanitation into a Bacteriological Institute – dependent upon the National Department of Hygiene, which would later function as a centre specializing in public health. For a description of the Bacteriological Institute's early years, see María E. Estébanez: 'La creación del Institute Bacteriológico del Departamento Nacional de Higiene: salud pública, investigación científica y la conformación de una tradición en el campo biomédico', in Mario Albornoz, Pablo Kreimer, and Eduardo Glavich (eds.), *Ciencia y Sociedad en América Latina* (Buenos Aires: Universidad Nacional de Quilmes, 1996), 427–440.

[20] This journal was the *Revista del Institute Bacteriológico Dr. Carlos Malbrán*, of the Department of National Hygiene. It was published annually from 1917. For the Malbrán Institute's activities in the early 20th century, see L. Aquino, 'El Profesor Doctor Rodolfo Kraus', *Rev. Circ. Méd. Arg. Cen. Est. Med.* XX, (1921), 35–36.

[21] Nancy Stepan, *Beginnings of Brazilian Science* (New York: Science History Publications, 1981), 74.

a space for training researchers (in conjunction with the University of Paris).[22] It was a unique institution, beginning life after a public auction and emerging as a private institution 'orientated toward the public sector'. Twentieth-century public health policy could not turn its back on the Institute's privileged status. The Institute gradually became a legitimising space for professional identification, both in France and abroad.[23]

In a similar way, bacteriology in Argentina became professionalized between 1924 and 1944, when Alfredo Sordelli was director of the Bacteriological Institute. Sordelli was a highly-regarded pioneer in research, and, with Houssay, a driving force in the transition from 'traditional' physiology and medicine towards the experimental approach emerging in the School of Medicine in Buenos Aires and some of the city's hospitals. In this period, the Institute's structure was defined. The production of sera and vaccines was combined with private practice and 'pure' research. With the exception of a handful of department heads in the Institute's upper echelons, staff did not devote themselves to full-time research. The professionalization promoted by Sordelli ensured that the mechanisms to encourage research were based on conducting a *concurso* (entrance examination); on sending scholarship holders abroad; and on inviting leading figures to shape the new departments.[24] Eventually, the organization was based upon a division of work into different autonomous departments, in which the establishment of priorities gave each director great autonomy.

During this period, attempts to promote full-time research exposed tensions between competing institutional models. On the one hand, the outbreak of epidemics required the Institute to be a centre for public health. On the other hand, the research model proposed by Rudolf Kraus, which bore fruit under Sordelli, led to the development of an incipient research

[22] Institut Pasteur, *1887–1987–2087. Un Nouveau Siècle* (Paris: Editions de l'Institut Pasteur, 1987).

[23] An eminent 'Pasteurian', André Lwoff, points out that 'Être pasteurien c'est donc appartenir à un ordre ... Consciemment ou inconsciemment, les pasteuriens sont imprégnés par l'histoire qui les cimente, unis par la lutte qu'ils poursuivent pour la connaissance, par le combat qu'ils mènent contre la maladie, par la marche en commun vers un but intemporel qui s'éloigne lorsqu'on croit l'atteindre.' André Lwoff, *Jeux et combats* (Paris: Fayard, 1981).

[24] In setting up the Virus Department in 1941, Sordelli managed to bring about an agreement between the Argentinean government (through the National Department of Hygiene) and the Rockefeller Foundation's International Health Division. By this agreement, the Argentinean government allotted special funds to set up the department, whilst the Rockefeller Foundation awarded scholarships to send two members of the Institute to the United States to specialize in respiratory viruses. For further information, see Alfredo Sordelli, *Creación y funcionamiento de una sección para el estudio de virus filtrables* (Buenos Aires: National Institute of Bacteriology Archives, 1942).

community and to important relationships with research centres abroad.[25] With this combined function, the Malbrán Institute began to take shape between 1956 and 1962.[26] In 1956, Ignacio Pirosky was appointed Interim Director by Dr. Francisco Martínez, Minister for Social Welfare and Public Health, with the explicit aim of reorganising the Institute. Pirosky felt that the 'first issue to address was the economic issue. It was essential if we were to stay in contact with the major scientific centres around the world'. Furthermore, Pirosky backed the Director of Public Health (*Director de Medicina Sanitaria*), in securing the 'necessary elements for the manufacture of top-quality sera and vaccines and the strict monitoring of the efficacy of certain biological medication. But principally the Institute *had to* become a centre for technical training and scientific research.'[27]

A year after Pirosky became Director, the old Bacteriological Institute became the National Institute of Microbiology. The new institution's goals were fivefold – to perform scientific research in the various microbiological disciplines in the spheres of both 'pure' research and its 'application' to public health; to manufacture serums and vaccines; to carry out microbiological diagnoses; to study the aetiology of endemic and epidemic diseases in the country; to promote active exchange with the major microbiological centres around the world; and to promote a system of grants and scholarships.[28] Within this scheme, the develop-

[25] Rudolf Kraus was the Institute's first director, from 1914 to 1921. Kraus studied medicine in Austria and worked for several years in various German institutes. He was closely associated with the emergence of immunology and bacteriology in Latin America. From 1921 to 1928, Kraus was the Director of the Butantan Institute in São Paulo, Brazil, and from 1929 to 1932, Director of the Bacteriological Institute in Chile. For further information, see Aquino, *op. cit.* note 20. Continuing this tradition, Sordelli encouraged channels of communication among institutions in the biomedical sphere (such as the Argentine Biology Society, set up by Houssay), including exchanges of personnel (including Houssay's assistant, J.T. Lewis, who was head of the Malbrán Institute's pharmacology department between 1924 and 1928).

[26] There is little data about the Institute under the Perón government (1946–1955). Our interviewees state unanimously that, owing to lack of funds, the Institute went rapidly downhill. They also mention an indirect relationship between events at the Institute and events at the University of Buenos Aires, when Houssay and Leloir and others had to resign their posts under political pressure.

[27] Ignacio Pirosky, *1957–1962 – Progreso y destrucción del Instituto Nacional de Microbiología* (Buenos Aires: EUDEBA, 1986), 33.

[28] Resolution No. 2.982 of 24 August 1956, which lays down the Institute's organizational and administrative structure. This was reinforced by Decree Law No. 3283 of 26 March 1957, and its amendment, Decree Law No. 16145 of 9 December 1957. The following departments were also set up: Virology; Clinical Pathology (Serological and Microbiological Diagnosis); Biochemistry and Biophysics; Biological Product Manufacturing; General Bacteriology; General and Comparative Pathology; Protozoology and

ment of research, as well as the coordination of the departments, was the exclusive responsibility of the director.[29] A modernization process was begun, giving priority to the development of 'basic' research in serum and vaccine production. The first experiment in molecular biology research in Argentina became operational on the following principles:

- The Institute purchased state-of-the-art equipment to encourage research.[30]
- A *concurso* was held to generate full-time technical-scientific staff; from this, ninety new researchers were taken on.
- Grants and scholarships were promoted for overseas training (approximately thirteen researchers left the country).[31]
- New research spaces were created for these young researchers so that they would be able to reinsert themselves upon their return to Argentina (this was especially important for those who worked in the molecular biology department, which would contain the bacterial genetics and molecular biology departments.

In one sense, these principles of modernization led to cognitive changes inside the institution by substantially modifying the institution's structure. These efforts were influenced by events in Argentina that opened fresh opportunities for tackling cognitive issues in different fields.

Applied Entomology; Pharmacy, Monitoring and Chemotherapy; Mycology; and the Genetics of Small Laboratory Animals.

[29] This scheme was marked by a trade-off between the 'Pasteur Model', where the head of each laboratory has a large degree of autonomy, and the 'traditional' Malbrán Model, where the Director always had great power over laboratory life.

[30] The list was impressive: automatic autoclaves for sterilization; freezers; a lyophilizer for sera and vaccines; a BCG vaccine production unit; centrifuges; one large-volume centrifuge; Spino preparative ultracentrifuges; analytical centrifuge; a Servall centrifuge; a Tiselius electrophoresis unit; a variant paramagnetic resonance unit; a Beckman DK-2 spectrophotometer; a radioisotope unit; crosscurrent units; an electron microscope; a Defonbrune microscope; sets of Mettler scales; Leitz optical microscopes; automatic pipettes; potenciometers; homogenizers; chromatography apparatus, and a neurophysiology unit.

[31] The list of scientists who emigrated is impressive: Cesar and Celia Milstein (Department of Biochemistry, Cambridge University), José Apelbaum (Instituto Di Patologia Speciale Medica e Metodologia Clinica, University of Siena), Julio Barrera Oro, (Baylor University, College of Medicine, Texas Medical Center), Manuel Brenman (Massachusetts Institute of Technology), Pablo Bozzini (Massachusetts Institute of Technology), Mariano Dunayevich (Department of Public Health, Viral and Rickettsial Disease Laboratory, University of California at Berkeley), Horacio Encabo (Faculty of Science, University of Paris), Ricardo Ferraresi (Pasteur Institute, Paris), Emanuel Levin (Department of Neurochemistry, Montreal Neurological Institute, and Department of Physiology of University College London), Antonio Lubin, (Communicable Diseases Center, Atlanta), and Jorge Raúl Periés (Pasteur Institute, Paris).

Emerging Research in Molecular Biology

Molecular biology in the late 1950s

To put these laboratories into context, it is vital to summarize the state of the field at the time. Although the term 'molecular biology' was in use in the 1930s, it did not become widespread until the end of the 1950s, with the appearance of the *Journal of Molecular Biology*.[32] During the 1950s, the expression did not yet signify a given field, but rather an innovation designating a new *hybrid* that could not as yet be identified, even by the scientists involved. Francis Crick, who proposed in 1953 – with James Watson – the 'double helix model' for the understanding of the DNA structure, stated that 'I myself was forced to call myself a molecular biologist because when inquiring clergymen asked me what I did, I got tired of explaining that I was a mixture of crystallographer, biophysicist, biochemist, and geneticist, an explanation which in any case they found too hard to grasp'.[33]

Only when the field began to establish itself, were its limits described with any clarity. With the publication of *Phage and the Origins of Molecular Biology* in 1966, practitioners saw that a new discipline had emerged, and began to trace its development.[34] Their history began with a succession of disciplines converging during the 1930s, that gradually

[32] The invention of the term 'molecular biology' is attributed to Warren Weaver, Program Officer of the Rockefeller Foundation's Natural Science Department. In 1938, Weaver went on record as saying that 'among the research the Foundation is lending its support to, is a series belonging to a relatively new field, which might be termed molecular biology. This research uses subtle modern techniques to study the ever more minute details of certain vital processes' (Olby, *op. cit.* note 1, 616–619). The programme supported fields of research rather than 'individual scientific leaders', thus providing the means for general mobility. Abir-Am believes that 'mobility factor' enables us to explain the appearance of molecular biology as a new socio-cognitive network of connections within the main divisions of biological disciplines, physics, and chemistry, and therefore enables us to explain the multidisciplinary nature of molecular biology, unlike other disciplinary fields. Pnina Abir-Am, 'From Multidisciplinary Collaboration to Transnational Objectivity: International Space as Constitutive of Molecular Biology', in E. Crawford, T. Shinn, and S. Sörlin (eds.), *Denationalizing Science: The Context of International Scientific Practice*, *Sociology of Science Yearbook*, XVI (Dordrecht: Kluwer, 1992), 153–154.

[33] Francis Crick, 'Recent Research in Molecular Biology: Introduction', *British Medical Bulletin*, 21 (1965), 183, quoted by Gunther Stent, 'That Was the Molecular Biology That Was', *Science*, 160 (1968), 390–395.

[34] *Phage and the Origins of Molecular Biology*, *op. cit.* note 2, edited by John Cairns, Gunther Stent, and James Watson, was published on the occasion of Max Delbrück's sixtieth birthday in 1966. For a recent account of the development of molecular biology, see S. De Chadarevian, *Designs for Life: Molecular Biology after World War II* (Cambridge: Cambridge University Press, 2002).

brought about the acceptance of a new level of analysis (the molecular level) as the basis for understanding reproduction in living organisms. After the Second World War, new science policy initiatives facilitated scholarly travel and the establishment of international networks. These in turn produced the kind of transnational context that made possible the key consolidating discoveries of molecular biology – namely, the structure of the double helix and the RNA messenger.

If we take as a guide the predominant tendencies described by the German biologist, Gunther Stent, we can identify three separate fields at the end of the 1950s:

1. *The Structural*: The study of the architecture of biological molecules, taken up by three groups: the first, headed by Linus Pauling at Caltech; the second, by Max Perutz (a disciple of Bernal) at the Cavendish Laboratory in Cambridge; and the third, led by Rosalind Franklin and Maurice Willkins at King's College, London.
2. *The Biochemical*: The study of the interaction of biological molecules in cellular metabolism and heredity, developed by the French group consisting of Lwoff, Jacob, Monod, and Wollman at the Pasteur Institute in Paris.
3. *The Informational*: The study of the ways in which information is conveyed from one generation of organisms to another, and the translation of information into biological molecules, developed by the so-called 'Phage Group', led by Delbrück, Luria, and Hershey.[35]

According to Stent, the period between 1953 and 1963 saw a 'dogmatic phase', dominated by James Watson and Francis Crick.[36] The theoretical importance of their discoveries stemmed from the fact that the search for the double helix was based on the introduction of genetic reasoning into structure determination. This later translated into the 'Central Dogma' of molecular biology. In this period, there were other important events in the consolidation of molecular biology, such as Lwoff's discovery of operon and the RNA messenger. Likewise, the English school of X-ray crystallography established the molecular structure of haemoglobin (Perutz) and myoglobin (Kendrew), while in the biochemistry laboratory at Cambridge, Sanger established the first complete sequence of amino acids for a protein (insulin). All these discoveries – which won the Nobel Prize – gradually shifted attention from proteins to nucleic acids and DNA.

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35 Stent, *op. cit.* note 33, 390–395.

36 *Ibid.*, 393–394.

The molecular biology laboratories

Argentina's first molecular biology laboratories opened in 1957, when Dr. Ignacio Pirosky was appointed Director of the Malbrán Institute.[37] This event could be viewed as an example of 'institutional transfer', inspired by the Pasteur Institute, where Pirosky had worked under Lwoff in the 1930s. However, the Malbrán Institute found it extremely difficult to make headway in basic research, owing to both political and professional limitations. Behind the *concurso*, two institutional models were in conflict: the traditional model of the Malbrán as an institute for services, and the Pirosky model, which saw the institute as devoted not only to 'applied' research (including epidemics control and vaccines production), but also to 'basic' research.

The first laboratories involved a shift towards a new way of thinking. The most visible effect of the *concursos* was the promotion of new, full-time posts. However, this generated 'occupational' conflict among the representatives of the 'old guard' (staunch supporters of tradition within the Institute) and the new generation entering the Institute in Pirosky's *concursos*.[38] After 1957, new departments were tailor-made for new staff and researchers returning from post-doctoral sojourns abroad. A department of bacterial genetics was added in 1957, and – upon Milstein's return from England in 1961 – a molecular biology department. Milstein was to head this department until 1962. Molecular biology subsumed the bacterial genetics department, as well as a group of previously 'independent' researchers.

These creations did not rupture the Institute's structure into autonomous departments. Rather, they emerged gradually within an organization that was based not upon any coherent design, but upon whatever orientation the director of the day decided. The arrival of molecular biology, with its innovative set of devices and techniques, brought with it a cognitive rupture. However, this rupture was not accompanied by a consequent

[37] Pirosky entered the Malbrán Institute in the early 1930s as an honorary, unpaid assistant, and carried out research on the fractioning of ordinary, antitoxic serums, specializing in the analysis of ultra-violet absorption spectra. Later, in 1935, he gained a position in the antitoxin and immunology department, and seven years later, he was heading it. He held this position until 1956.

[38] The young chemistry major, César Milstein, speaks eloquently: 'The Malbrán Institute was quite old. . . . After a period of long neglect, it received a fresh lease of life with Dr. Ignacio Pirosky. The Government granted him special concessions, which allowed him to take on a great number of young scientists in full-time key positions. This was a bold and imaginative stroke but it placed Pirosky and the new young scientists in direct conflict with the sclerotic old guard. However, [during those years] an atmosphere of great scientific excitement developed among the recently hired scientists.' Pirosky, *op. cit.* note 27, 29.

change in organizational form, and to a large extent, 'traditional' institutional settings prevailed.

Of the two new departments, the first was in bacterial genetics. This comprised the biologists, Rosa Nagel and Juan Puig.[39] A year later came the geneticist Dora Antón, from the School of Exact Sciences at the University of Buenos Aires, where she had held a post in the Department of Genetics under the agriculturist, Juan Valencia.[40] Until then, the field of Argentinean genetics was dominated by agriculturists interested in hereditary features in crop varieties. With the mid-1950s, came the first developments in microbial genetics. The creation of the bacterial genetics department at the Malbrán brought about significant thematic and conceptual innovation.[41] Investigations at the molecular level, using virus systems (phages), established DNA as the 'transforming principle'.[42] A line of research centred on the study of prophages and the features of RNA messengers, in which the 'French school', represented by Lwoff, Monod, Jacob, and Wollman, played a dominant role.

Elie Wollman's participation was crucial to the new laboratory. Wollman visited the old Institute of Bacteriology in 1929, when his parents were invited to establish a link between the Malbrán and Pasteur Institutes.[43] Collaboration followed, and Pirosky was invited to the Pasteur Institute to work under Lwoff in 1936 and 1937. Pirosky's presence responded to an explicit strategy of incipient 'internationalization',

[39] It is crucial to note that biology training at the University before 1960 was a very 'traditional' (taxonomic) one, and most of the prestigious scientists working on biological research were medical doctors or biochemists.

[40] The biologist, Pablo Bozzini, who went to MIT for post-doctoral studies and rejoined the Institute in the early 1970s when its laboratories had been dismantled, was also a member of the department.

[41] The first genetics institute belonged to the School of Agronomy and Veterinary Medicine of the University of Buenos Aires, headed by the agriculturist, Dr. Salomón Horovitz. The first degree courses in genetics were given by zoologist, Miguel Fernández, who specialized in embryology, at the National University of La Plata, while at the University of Buenos Aires, the pioneer was Angel Gallardo, head of the Zoology Department in the School of Exact and Natural Sciences. See Hebe Vessuri, 'El hombre del maíz en la Argentina. Salomón Horovitz y los modelos de rol en los años pioneros de fitomejoramiento en Sudamérica', paper presented at the XXth International Congress of History of Science (Mexico City, July 2001), and Jorge Katz and Nestor Bercovich, *Biotecnología y economía política: estudios del caso argentino* (Buenos Aires: Centro Editor de América Latina, 1990), 82.

[42] We refer to the work by Avery in 1944, which established DNA as the transforming principle of pneumococchi.

[43] Personal letter from Elie Wollman, June 2000.

supported by the Rockefeller Foundation, whose program director exerted a great influence over the young Jacques Monod.[44]

According to Wollman, '... when Pirosky became director of the Malbrán Institute, he went to the Pasteur Institute, and told Lwoff about his plans for innovation and, in particular, for the recruitment of a small number of young Argentinean scientists who wished to turn to bacterial genetics. Lwoff, who knew about my long-standing links with Latin America, urged me to accept.'[45] So in August 1958, Wollman went to Buenos Aires and enlisted Juan Puig, Rosa Ángel, Pablo Bozzini, and Dora Antón. The group set up in the 'Pasteur Pavilion' of the Buenos Aires Institute. Wollman brought the biological material, and devoted himself to the laboratory while lecturing in the Faculties of Science and Agronomy. Puig, Nagel, and Antón presented their doctorates the following year.

Unlike the bacterial genetics laboratory, the creation of the Molecular Biology Division, headed by Cesar Milstein, was linked to the so-called 'structural', or British tradition in molecular biology. Milstein worked with a medical doctor, Andrés Stoppani, in the School of Medicine, where Stoppani headed the Institute of Biological Chemistry. In 1957, he entered the Malbrán Institute, where Pirosky gave him leave to do a doctorate in Cambridge. At Cambridge, molecular biology revolved around two groups – the first, led by Perutz and Kendrew at the Cavendish, specialized in X-ray diffraction of molecular structures of proteins; while the second, headed by Frederick Sanger, at the Biochemistry Department, specialized in new chemical techniques and amino acid sequences. Milstein went to Sanger's group, where he worked on enzyme activation and amino acid sequences in active enzyme centres. The experience gave him a knowledge of protein chemistry and kinetic enzyme analysis.[46]

When Milstein returned to the Malbrán, Pirosky appointed him Director of the Molecular Biology Division. This consisted of Milstein, Noel Zwaig (Rosa Nagel's husband, who worked in the division founded by Wollman), Marta Pigretti, Celia Milstein, Manuel Brenman, Nazario Mahafud (a scholarship holder), and Horacio Farach, Teodoro Celis, Inda Issaly, and Abel Issaly (all writing their PhD dissertations). Under Milstein's management, bacterial genetics merged with this division; however, in practice, the laboratory was a great deal more independent than other groups run by Milstein.

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[44] The use of the phrase 'internationalization strategy' derives from the hypothesis formulated by Abir-Am, *op. cit.* note 1.

[45] Personal letter from Elie Wollman (undated, ca. June 2000).

[46] Interview with César Milstein, Cambridge, 10 January 1999.

Its first line of research was directed by Milstein, who continued what he had done at Cambridge, and took further the development of techniques for the study of sequencing and marking the active centres in phosphoglucomutase, phosphoglyceromutase and alkaline *E. coli*. A second line of research was directed by Dr. Manuel Brenman, who specialized in nuclear magnetic resonance. His group began in late 1961, after Brenman returned from studies in nuclear magnetic resonance in the Chemistry Department at MIT.

Cognitive liberalization and international referents

Wollman's leadership and Milstein's return from Cambridge were key factors in the emergence of the new discipline in Argentina. Lwoff's group at the Pasteur Institute, together with Perutz's at Cambridge, and that at Cold Spring Harbor in the USA, were among the few devoted to the new discipline. Thus, of the three major international groups, molecular biology in Argentina had close ties with two. The formation of the new laboratories was also linked with one of the privileged forms of innovation in the Argentinean scientific community. A form of integration was achieved, by subordinating Argentinean science to 'mainstream' international science.[47] In this 'peripheral context', there were two ways of setting new agendas – by bringing in scientists from abroad, and by hiring researchers who had completed their studies overseas.[48] Both strategies were employed.

[47] See Kreimer, *op. cit.* note 5. See also Vessuri, *op. cit.* note 6; Roy MacLeod, 'On Visiting the "Moving Metropolis": Reflections on the Architecture of Imperial Science', in N. Reingold and M. Rothenberg (eds.), *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, DC: Smithsonian Institution Press, 1987), 217–249; J. Gaillard, 'North-South Research Partnership: Is Collaboration Possible between Unequal Partners?', *Knowledge and Policy*, 7 (2), (1996), 31–63; Y. Chatelin and R. Arvanitis, 'Between Centers and Peripheries: The Rise of a New Scientific Community', *Scientometrics*, 17 (5–6), (1990) 437–452; J.J. Salomon, *The Uncertain Quest. Science: Technology and Development* (Tokyo: UNU, 1994); S. Goonatilake, *Aborted Discovery: Science and Creativity in the Third World* (London: Zed, 1984); and P. Petitjean, *et al.* (eds.), *Sciences and Empires: Historical Studies about Scientific Development and European Expansion* (Dordrecht: Kluwer, 1992).

[48] In addition to Wollman's course, a course on the problems of experimental design in biology and medicine and their interpretation was given by Dr. Ferting, the biostatistician, who came to Argentina in 1960. This responded to Pirosky's explicit strategy: 'From the moment I became Director of the National Institute of Microbiology, I believed that the way to ensure permanent scientific progress in microbiology and related sciences would be to maintain a *constant, dynamic relationship with the most advanced centers in the world*, not only through exchanging publications, but *by inviting scientific figures* to offer specialist short courses and *sending grant holders to highly specialized centers*.' See Pirosky, *op. cit.* note 27, 251, our italics.

Pirosky sent the Institute's scholarship-holders to centres specializing in relevant areas. In every case, he kept up-to-date with their progress, their equipment, and their research, so that they could continue work they had been doing abroad. The strategy deployed by Pirosky in sustaining a network with 'centres of scientific excellence' working in the field of molecular biology, was tied in with a strategy to use foreign recognition to improve local standing. In fact, much research was done under Pirosky, who succeeded in finding funds to pay full-time salaries and purchased scarce equipment.[49] These resources came mainly from the Ministry of Public Health, thanks to support from the minister of the day, and, to a lesser extent, from the recently created CONICET, on the board of which Pirosky was a member.

Although he did not align himself politically with the hegemonic group in CONICET (Bernardo Houssay and his disciples), but rather with the 'innovative group' headed by Rolando García (Dean of the Science School in the University of Buenos Aires), Pirosky's presence did institutionalize the groups at the Malbrán Institute as a legitimate space recognized by the Argentinean scientific community at large. The existence of an established scientific tradition in biomedical research became the cornerstone of conceptual innovation in molecular biology. Even if scientists did not realize that molecular biology actually represented an innovation, they tended to favour new research techniques that broadened without disrupting 'traditional' biology. Moreover, during the 1950s, biochemistry was dominant within the local community, and this was a limiting factor.

The last and most important point concerns the relationship between the Malbrán laboratories and the local scientific community. The movement, spurred by Pirosky, was inscribed within a tradition represented by Alfredo Sordelli, as well as within a network of modernizers, who went beyond this tradition. Sordelli was identified with a generation that institutionalized experimental research through methodological rigour and international networks. This institutionalization began in the early twentieth century, was temporarily challenged during the Peronist period, and then re-emerged in 1956. In this sense, close relations with the Cori couple and Severo Ochoa in the United States, with the Pasteur Institute in Paris, and with the Rockefeller Foundation, all indicated a 'modern' way of doing science that had taken root in Argentina. However, by the end of the 1950s, this model was looking out-of-date, at least when compared with two transformations on the international stage – the emergence of 'Big Science',

[49] The equipment in the molecular biology department was valued at US $150,000, a large sum for the Institute.

and the impressive development of the biomedical sciences, which made intensive use of new techniques and equipment.

The laboratories' demise

The Malbrán's molecular biology laboratories were dismantled in 1962, when Pirosky was removed as director by the newly-appointed Minister of Public Health. This led to a breakdown in a process that had come of age in the years between 1957 and 1962. A number of measures completed the breakdown: full-time posts were limited, and most of the staff were dismissed.[50]

In the circumstances, Pirosky's institutional project, linking public health objectives with the development of research, found itself in competition with the type of specialization defended by 'the old guard'. This model was backed by the new authorities at the Ministry of Social Welfare and Public Health, as well as by the School of Medicine at the University of Buenos Aires. In reviewing the Malbrán Institute, they reported that 'the activity attributed to this body has not been carried out, where aspects directly relating to the problems of public health are concerned ... that, therefore, supplies of certain essential products have in some cases been outstripped by needs ... and that the necessary measures have not been taken to solve the shortcomings in production processes, while other measures did not fit with the needs of the Institute ...'.[51] This apparent failure to serve its appointed function led to the dismissal of twelve researchers, six of whom belonged to the molecular biology department. This, in turn, led to the resignation of another thirteen researchers, six of whom were in the same department. Thus, the first molecular biology laboratories in Argentina were effectively disbanded.[52]

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[50] Milstein's words to the interim director on resigning speak volumes: 'I am not aware of the selection mechanism that has been used .... I have been passed over, though I am ... the only person in a position to judge the relative importance of the work being carried out by the researchers in the molecular biology department. ... [Perhaps] you did not consult me because it is your opinion that *all the work being done in this department is useless for the Institute*. I must add that this interpretation is consistent with Minister Padilla's statement, in which case I personally feel I am one of those who are prompting the so-called 'misuse of state funds'. Milstein's letter of resignation, March, 1962.

[51] Pirosky was accused of handling resources in such a way as to have violated administrative rules. According to the (confidential) testimony of one researcher at the time, there were grounds for this accusation – not that Pirosky profitted personally, but that there were 'bureaucratic oversights' that freed up the administration of funds.

[52] Owing to the subsequent lack of specialist staff, the equipment in these laboratories was left in a storeroom until some of it was used more than fifteen years later. The rest was placed in storage (where it still lies today), and has become obsolete.

Following their departure, these pioneering researchers continued their careers abroad. The development of new techniques and the modification of practices involved in the introduction of the new science of molecular biology were virtually lost to Argentina, as the researchers dismissed from the Malbrán Institute went abroad: Milstein returned to Cambridge; Nagel, after a short period as professor of genetics at the University's School of Exact Sciences, went to the USA to work with Luria; and Puig joined a CNRS Institute in Marseilles. Luria and Puig returned to Latin America at the end of the 1970s, but to Venezuela, not to Argentina, where they could not return because of the military dictatorship installed in 1976. Despite its pioneering prospects, molecular biology was lost to Argentina for more than a decade. It was impossible to nourish the discipline in the university schools of exact sciences or medicine, or in laboratories belonging to CONICET.

Conclusion

This article has described an institutional and disciplinary innovation that derived from a strategic vision of communication and collaboration between a peripheral institution and established metropolitan networks.[53] We have suggested that this innovation is best explained using the language of *subordinated integration*, by which peripheral scientists accept the costs of working on an international scene. Second, this article has shown how the creation of the molecular biological laboratory at the Malbrán Institute responded to a project of modernization that sought to establish basic research as its central axis. This process was strengthened by the emergence of science and technology policy in Argentina. Nevertheless, the process was cut short. The strategy failed – in large part because the discipline was not sufficiently stable, even when allowed entry into a powerful field. The interests of the 'pioneers' could not overcome the opposition of those who saw different, more practical objectives as the legitimate functions of the Institute.[54]

In this case of institutional rise and fall, we see at least four factors at work.

First, *a struggle between two institutional models*. The attempt made to establish a new model did not manage to break with the inherited

[53] Our field research has demonstrated that post-doctoral study trips are very often a crucial catalyst in thematic, conceptual, and methodological innovation in peripheral countries. See Pablo Kreimer, *L'Universel et le Contexte dans la Recherche Scientifique* (Lille: Presses Universitaires du Septentrion, 1999).

[54] It is worth recalling Lwoff's and Crick's statements quoted above.

institutional logic. Instead, a confrontation took place between young researchers, who defended the 'laboratory' model, and tried to emulate the Pasteur Institute of Paris, and the institution's elder members, who had strong links with the University's School of Medicine and defended a 'public health' model, by which the institution concentrated on the production of sera and vaccines, and on epidemiological control. Strictly speaking, this conflict was never resolved, and when the Minister of Public Health, who supported Pirosky's strategy, was replaced by a different minister, who supported the traditional faction, there was no room left for innovation. Thus, the laboratories were dismantled.

Second, *a struggle between 'traditional' and 'modern' research practices in biomedical sciences*. Pirosky, Milstein, and the 'new generation' were aligned with new trends that involved a conceptual innovation (an understanding of the intracellular level of biochemical interactions), a thematic innovation (the study of DNA structure, sequence and expression, the role of messenger RNA), a technical innovation, and the use of a new set of devices. It may seem paradoxical that Houssay and Leloir, who had played a leading role in the modernization of research (and who received international recognition in the form of Nobel Prizes), were, in the late 1950s, representatives of an 'obsolete' model of investigation, and effectively curbed the emergence and development of molecular biology in Argentina.[55]

Third, *the weakness of the political and institutional context for science and the role of politico-military intervention in Argentina*. To ask what would have happened if such intervention had not taken place in 1962 is to ask a counterfactual question. However, 1962 was not a year that stood out for government interventions – unlike 1966, for example, when ideological conflicts and interventions did take place, on a massive scale. On the contrary, what happened in 1962 was just a change of ministers. However, it can be argued that the 'success' of a new minister in closing the laboratories can be best understood in terms of the weaknesses peculiar to the discipline in question, the specific institutional sphere, and the tensions generated in it.

Overall, we can see how the Malbrán molecular biology laboratories were strongly linked to the three main schools existing in the late 1950s: the American, the French, and the British. We see that international links

[55] After Pirosky's departure from the Malbrán Institute, Milstein turned to CONICET for help. There he spoke with Luis Leloir, and asked him to intercede. According to Milstein, Leloir did not pay much attention to him, and wrested importance from both the current political situation and the topics being researched in the dismantled laboratories. Milstein asked if he could work at the Campomar Foundation, but, after Leloir's refusal, he decided to return to England. (Interview with César Milstein, Cambridge, January 1999.)

were established, but at a time when the field was not 'mature' at an international level. Still, internationalization was not a hazardous feature of this field, but a key factor in its development. As Abir-Am has pointed out, 'international space in which molecular biology has been operating since its inception . . . helped constitute the new field by providing freedom from social control and institutional resistance in national settings . . .'.[56] Moreover, in spite of its 'peripherality', Argentina had a relatively strong tradition in physiology and biochemistry, with several research groups effectively integrated into international networks. Given these factors, it is useless to look to a 'simplistic' (or 'diffusionist') approach to explain why the experience failed. The active and enthusiastic 'reception' of new fields and new research topics by the local community was, in fact, behaviour commonly observed in Argentina. Political and military interruptions in the 'republic of science' were a permanent menace. Consequently, we believe that it is only by examining the intersection of political, institutional, cognitive, and organizational factors, that the development of the Argentinean scientific enterprise can be fully understood.

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[56] Abir-Am, *op. cit.* note 32, 176–177.

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