Microbiology in Mexico and Brazil in the late-XIX and early-XX centuries

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Abstract

The assimilation of microbiology in Mexico in the late-XIX and early-XX centuries provides an interesting similarity with the same process in Brazil. Both countries had been colonies of European powers: of Spain in the case of Mexico and of Portugal in that of Brazil. This characteristic offers an excellent point of departure for this article, which analyses briefly the historical similarities and differences between both countries in the process that resulted in the gradual incorporation of microbiological knowledge into local understanding.

Keywords: Microbiology; Scientific knowledge; Asimilation.

Microbiologia no México e Brasil no final do século XIX e começo do século XX

Resumo

A assimilação da microbiologia no México, no final do séc. XIX e início do séc. XX, apresenta uma interessante similaridade com este mesmo processo no Brasil. Ambos os países, em dado momento, foram colônias européias; da Espanha, no caso mexicano, e de Portugal, no caso do Brasil. Tal característica oferece um excelente ponto de partida para este artigo, que analisa brevemente as semelhanças e diferenças históricas entre os dois países, no processo que se aborda, que os levam à paulatina incorporação do conhecimento microbiológico ao seu saber científico local.

Palavras-chave: Microbiologia; Conhecimento científico; Assimilação.

Introduction

As Thomas Glick has observed

> *The development of science as an organized activity in Latin America has rarely been smooth or lineal. Rather it has been replete with false starts, with periods of consolidation followed by periods of fragmentation and reverse, often for political reasons.* (Glick, 1995)

This article tests this hypothesis by analysing the process in two leading Latin American countries – Mexico and Brazil – in the late-XIX and early-XX centuries, when attempts were made by the governing elites to promote the implantation of new bacteriological practices and theories recently developed in continental Europe. As is well known, both countries had been European colonies for three centuries until acquiring independence, initially as monarchies, in 1821-1822. Thereafter, their national development was different, not least because Mexico adopted a republican constitution in 1824, whereas Brazil retained monarchical institutions until 1889 (and black slavery until 1888). Nevertheless, their shared colonial experience profoundly affected the ways in which they responded in the post-independence period to the challenge of assimilating modern ways of undertaking science, particularly during the last quarter of the nineteenth century and the first decades of the twentieth when the process of modernisation was in full flow in both countries, particularly under the influence of French-inspired Positivism. The experience of colonialism continues, arguably, to put a brake upon scientific activity. However, despite this common experience, as this essay will show, there were also deep differences and contradictions which gave special characteristics to the implantation of modern science in the respective countries.

In this paper I offer an analysis of these similarities and differences in the development of bacteriology in the late-XIX and early-XX centuries in these two Latin American countries. This period coincides with the attempt of the French government to construct a map – or it might be called a census – of diseases and their causes throughout the world. The driving force behind this policy was the strategy of the medical specialists of the French navy to create a new structure of scientific authority and professional power which would legitimise their activities in the eyes of the State and, at the same time, assist them to consolidate and defend their professional status vis-à-vis other power groups in the French medical hierarchy (Arnold, 1996). It is highly likely, although difficult to document precisely, that this vision of mapping the medical world, was shared by the medical service of the French army, whose doctors

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collaborated with the naval project. Thus, we find in the Mexican case, the sudden arrival in the country in 1906 of the French military doctor, Joseph Girard (1876-1916?), a former student of the distinguished French scientist Emile Roux (1853-1933), who had become director of the Pasteur Institute of Paris after the death of Pasteur himself. More details of Girard's career in Mexico are provided below.

This process of diffusion of bacteriology started during the second half of the XIX century. As a result of the researches and publications of Louis Pasteur (1822-1895), ideas about the existence of microscopic organisms and their causal role in the transmission of infectious diseases in both men and animals had started to take root amongst the European scientific communities during the second half of the nineteenth century, and very soon, first, this new understanding of the causes of infectious diseases and, second, the quest for measures to combat their effects (not only strictly medical but also social and economic) began to be diffused to the rest of the world.

Latin America – this controversial definition was also a European invention of the nineteenth century, but it is used here for the sake of convenience – was also participating in the diffusion of this new scientific knowledge. Countries such as Mexico and Brazil already possessed by the second half of the nineteenth century small but influential scientific communities capable of reacting to new ideas arriving in particular from Europe (they preferred for good historical reasons to look to Europe rather than the United States for their cultural and scientific inspiration) and to start the process of assimilating the new paradigm into scientific practice in particular and the broader modernisation process in general. However, it is important to stress that what occurred was not simply a slavish attempt to copy what was happening in Europe for, as noted, there already existed a small, but influential scientific base which was capable of providing the foundation for the assimilation process. In Mexico, for example, there existing not only a profound medical knowledge based upon pre-Hispanic traditions (some of which continue in the XXI century to be of great importance) but also over three centuries experience of medical practice and training in the University of Mexico (the forerunner of today's mighty Universidad Nacional Autónoma de Mexico). The Mexican medical community was well-prepared, therefore, to understand and promote the diffusion of new ideas arriving from Europe, although the institutions established to facilitate that process – notably the Instituto Médico Nacional (National Medical Institute) and the Instituto Patológico (Pathological Institute) were not created, as we shall see, until the last decades of the nineteenth century (Priego, 2002).

The Brazilian case was somewhat different. Prior to securing independence from Portugal Brazil possessed absolutely no higher education institutions, other than the peripheral bodies established following the flight of the royal family from Lisbon to Rio de Janeiro in 1808 (for example, a military academy). Throughout the colonial period Brazilians seeking university education had to travel to either the University of Coimbra in Portugal or, in a few cases, to universities in Spanish America (those of Lima or Chuquisaca, for example) or other foreign countries. There is some evidence that from the second half of the XVIII century, the native-Brazilian and Portuguese intellectual elites in Brazil displayed a consciousness of the importance of technical and scientific education, particularly as a reflection of the metropolitan authorities' attempts to promote economic growth. Indeed, in some respects, Brazil was ahead of the metropolis, because in 1772 it had witnessed the foundation of the Academia Cientifica (Scientific Academy), which predated anything similar in Lisbon. This Academy was dedicated to agrarian development, botanical research and natural history. Later – in 1779 – the Academy became the Sociedad Literaria (Literary Society) and its interests became wider: chemistry, physics, astronomy and metallurgy were included in its new interests. However, just as in Spanish America a number of Societies of the Friends of the Country fell victim to the conservative reaction in Europe to the French Revolution, this Society was dissolved by the viceroy of Brazil, the Conde de Resende in 1790 in an attempt to avoid the spread of the new "dangerous ideas coming from Europe"; at that time it had the biggest library in the viceroyalty (Fisher, 1990, p. 651-654). In the post-1790 period the colonial authorities, in both Lisbon and Rio de Janeiro, attempted to stress the importance of economic rather than intellectual and cultural activity. There is some evidence that the ideas of Rousseau, Montesquieu, Voltaire, Condillac, and other enlightened writers continued arriving in Brazil prior to 1808, but cultural life in general remained very backward until the royal library (and Brazil's first printing press) was brought by the royal family (Fisher, 1990). The rapid cultural development of Brazil during the second decade of the nineteenth century, the relatively peaceful nature of the transition to independence, and the relative political stability of the monarchical period all served, however, to promote both economic and cultural growth in the post-independence era – at a time when Mexico was racked by instability and the loss of half of its national territory to the United States. The cultural gap inherited by the two countries from their colonial experience had narrowed, therefore, to some degree, by the time that Brazil, like Mexico, attempted in the late-XIX century to adopt and

adapt the new European bacteriology through the creation of scientific institutions supported by both the monarchical and republican regimes. As we shall see, the process was neither continuous nor coherent.

This paper attempts to provide a comparative analysis of the development of microbiology in these two major Latin American countries, looking for similarities and differences between them. It does so bearing in mind the similarities – and to a lesser degree the differences – in their historical evolution in both the colonial and immediate post-independence eras. This process began in the last quarter of the nineteenth century, in countries which, despite their common experience of colonialism, had become quite different in terms of, for example, their racial and social structures. However, what they shared was a quest for modernisation, inspired by European models and theories, of which by most influential was the Positivist philosophy of the famous French thinker, Auguste Comte.

Background: Louis Pasteur

Louis Pasteur was born in France in 1822 and, after a wide-ranging scientific formation (which has been studied and analysed from very different angles by a wide range of scholars),[1] he published in 1865 six brief, but very important, articles about wine diseases (Vallery-Radot, 1922, p. 122-128), the silkworm disease and spontaneous generation. In these works he revealed his reasons for assuming the existence of a relationship between infectious diseases and the fermentation processes he had been studying (Pasteur, s. d., p. 37-42).

At this point in his career, as is well known by historians of science, Pasteur was able to establish and demonstrate a vital relationship between the causes and the transmissibility of infectious diseases, at the very time that Paris was suffering from a new cholera epidemic. In addition, he discovered that it was possible to prevent wine diseases by exposing the wine for a short time to a temperature close to 50 degrees centigrade. This procedure did not (and, of course still does not) have any harmful effects on the quality of the wine, but had the major advantage of preventing the proliferation of damaging micro organisms (Vallery-Radot, 1922). His contemporaries were reluctant at first to recognise the importance of the process – known to posterity, of course as "pasteurization" – partly because of scientific conservatism; the hostility of German scientists in particular, which is described below, was also compounded by a mutual antipathy between French and German scholars arising in part from the Franco-Prussian war of 1870.

The discoveries about the microbial nature of the diseases studied by Pasteur reinforced his conviction about their relationship with animal and human diseases. Thus, Pasteur focused his studies upon them, with absolute success. Hen cholera, anthrax, red pig fever and rabies were the first infections studied by Pasteur, and the results of his researches provided him with a sound theoretical and practical platform for successfully undertaking a subsequent, and better-known, experiment. This involved the attenuation of cultures of pathogenic organisms for subsequent use for inoculation, with the aim of achieving host immunization (Dalvar, s. d.).

As noted above, Pasteur's works had not been welcomed by all French scientists; German scientists, too, were sceptical about his findings, which became the subject of not only polite controversy and discussions in the main scientific out of the period but also of angry and impassioned public debate. The vigorous detractors of Pasteur were led by the prominent German scientist Robert Koch (1843-1910), who mounted a determined campaign to undermine and disqualify Pasteur's experiments within the German scientific community, arguing that they lacked sufficient scholarly rigour.[2]

The controversy was a major one and attracted widespread attention not only in France and Germany but also in other major European countries, as both men were notable scientists, with international reputations and it was impossible for observers of the conflict to doubt their academic prestige. Although Pasteur and Koch were never reconciled at a personal level – for example, Koch declined an invitation to attend the opening of the Pasteur Institute of Paris – the passage of time eventually took some of the heat out of their scientific conflict, as the broader scientific community accepted the fact that their approaches to the controversy were, in fact, complementary rather than antagonist. Pasteur was above all an intuitive thinker, as befits a Frenchman, while Koch, as a good German, was more rigorous in both his theoretical and practical approaches to science. In the short time, Pasteur received eventually the fame that he believed he deserved: in 1888 the construction of the Pasteur Institute began in Paris and, by 1889 it was almost finished. Many donations were received from foreign governments and from national and foreign organisations and individuals that had benefited in some way from Pasteur's works. The government of Alsace, for example, made a generous donation in recognition of Pasteur's success in curing a number of its soldiers who had contracted rabies (Latour, 1994). In November 1889 Pasteur was named Perpetual Secretary of the French Academy of Sciences and received many other awards and honours from both home and abroad. Moreover, plans were soon drawn up for the inauguration of Pasteur Institutes in Lille, Constantinople and in the France's African colony of Tunisia. However, Pasteur did not live

long to enjoy this fame, as his health declined quickly and he died in Villeneuve-l'Etang, on 27 September 1895.

Diffusion in America: Mexico

Throughout the second half of the XIX century, Pasteurian scientific ideas were rapidly diffused across the world and the American continent was no exception in this process.[3] The Mexican medical community had been in touch with the developments in Europe described in the previous section of this paper, and had sent representatives to France and other European countries as frequently as possible to participate in congresses and from 1889 to visit the Pasteur Institute. During his visit to Paris, the president of Mexico's National Academy of Medicine, Eduardo Liceaga (1839-1920)[4] visited the Pasteur Institute and made an agreement with its Director, Emile Roux (1853-1933), a close collaborator of Pasteur, to enable him to secure both the training and the materials required to produce in Mexico anti-rabies vaccine. Moreover, on his return to Mexico he mounted a successful campaign to establish the country's first Instituto Antirrábico (Anti-rabies Institute), an organisation which continued to function throughout the twentieth century (Liceaga, s. d.).

Throughout this period, Mexico was under the control of Porfirio Díaz (1854-1915), repeatedly re-elected as president in the period 1884-1910, before retiring to France in 1911 following the outbreak of the Revolution of 1910. Having been profoundly influenced by the Positivist ideas of "Freedom, Order and Progress",[5] Díaz had committed himself to the task of bringing peace to Mexico and encouraging its scientific development, as a part of a broader quest for international recognition. A chair of microbiology already existed by 1886 in the Escuela de Veterinaria (School of Veterinary Science) (Cervantes, 1999) and, in February 1888 another was established in the Escuela de Medicina (School of Medicine). This second chair was filled by Angel Gaviño (1855-1921), a close associate of Eduardo Liceaga, a member of the Academia Nacional de Medicina, and senator representing the state of Querétaro.[6] Gaviño had studied in the Escuela Nacional Preparatoria (National Preparatory School) – the most influential body promoting Positivism in Mexico – before entering the Escuela Nacional de Medicina. As a member of the close circle around Díaz, he was clearly identified as a firm adherent of French Positivism, and his appointment to the chair clearly reflected the powerful influence of this school of thought upon Mexico's small but influential medical elite. The number of students registered to take the course in bacteriology offered by Gaviño in the Escuela de Medicina increased rapidly and within a short time the range of provision was increased with the inauguration of a second course, and the decision to make both courses obligatory for all students of medicine. As the influence and prestige of bacteriology increased during the last decade of the nineteenth century and the first decade of the twentieth, its new adherents within the medical profession began to offer instruction that was sometimes sub-standard. The principal reason for this unfortunate problem was that the teachers concerned tended not to have the appropriate training and experience in what was, after all, a new science. To counter this trend, Gaviño tried to use his influence to bring about the creation of a new Instituto Bacteriológico, in part to provide retraining for existing medical practitioners.[7] As we shall see below, although this initiative eventually came to fruition in 1905, the process was more complex and difficult than Gaviño – its first director – had anticipated.

In 1889 the Secretaría de Fomento (Ministry of Development), headed by Joaquín Baranda[8] instructed Gaviño to travel to France; the surviving documentation does not fully articulate the reasons for his visit, but the timing and subsequent events lead us to the conclusion that the reason for the visit was to represent Mexico at the inauguration ceremony of the Pasteur Institute of Paris. When Gaviño returned to México, he was convinced of the need to create in Mexico a bacteriological institute similar to the new Pasteur Institute. His proposal was considered in the first instance by the Sociedad Médica Pedro Escobedo (Medical Society Pedro Escobedo), a somewhat shadowy group of medical specialists, which received some financial support from the State. His initiative was accepted by the Society. However, the Society itself lacked the resources to put it into practice, and, for reasons which remain unclear, other, more powerful, bodies showed little immediate interest in backing the initiative. One persuasive possibility is that other scientific institutions already mentioned which had a similar commitment to the fostering of microbiology – notably the Instituto Médico Nacional and the Instituto Antirrábico – were reluctant for political and/or personal reasons to enhance the prestige of Gaviño at the expense of Liceaga, who was not a member of the Escobedo Society. In Mexico, as in other Latin American countries, personalism has always been a powerful factor in national life, although it is often difficult for obvious reasons to document it.[9]

In the event good sense prevailed, but it was not until 1905 that Gaviño's plans came to fruition with the inauguration of the Instituto Bacteriológico, derived from the Bacteriological Section of the Instituto Patológico. The principal responsibilities of the new institute, according to an early edition of its Boletín, were defined as

the study of the relationships between infectious diseases and bacteriology, and the preparation of vaccines and anti-toxic sera to prevent and combat them, undertaking at the same time the studies of chemical biology considered indispensable for the proper examination of toxins… and other bacteriological products.[10]

Not surprisingly – again bearing in mind the perpetual nature of academic politics in Mexico – problems and rivalries soon emerged between the new Bacteriological Institute and the older Pathological Institute, with each seeking to undermine and call into question the work of the other. A good example is provided by their hostility with respect to studies about the transmissibility of typhus, which led rival teams of researchers to claim to have identified the causal agent.[11] An important part in this controversy – and in the other research programmes of the Bacteriological Institute – was played by the aforementioned French bacteriologist, Joseph Girard, who had been contracted by the Director, Gaviño, to stay in Mexico, as deputy-director of the Institute's microbiological laboratory.[12] Girard's expertise and knowledge was of critical importance to the work of the Institute. When personal problems between him and Gaviño came to a head in 1913 (for complex reasons which need not concern us in this paper), resulting in Girard's return to France, the long-standing quest of Mexican researchers to win the race to identify the micro organism responsible of typhus was undermined (Priego, no prelo).

In any case, despite the commitment and efforts of the Biological and Pathological Institutes, and the provision of modern, well-equipped laboratories (during, let us not forget, a period of bitter civil war, underway since 1910), the Mexican team was at a disadvantage in this race in comparison with the participants from France, the United States, and Germany. For example, there were persistent difficulties in securing the timely arrival from Europe of the chemicals and monkeys required for laboratory tests; the latter problem was partially solved by the use of monkeys indigenous to Mexico. Inevitably, these arguments, in which a prominent role was played by Charles Nicolle (1866-1936), Director of the Pasteur Institute in Tunisia, consumed valuable time and resources. Nicolle (who would be awarded the Nobel Prize for Medicine for discovering the causal agent of typhus) seems, incidentally, to have enjoyed a close personal relationship with Girard (1902) – they had both been students of Emile Roux in Paris – and it is now clear (although this will be the subject of a separate paper, currently in preparation) that the latter secretly supplied him with the results of the Mexican experiments in the hope of ensuring that the glory winning the race should be enjoyed by France. Mexico not only lost the race, but its team soon disappeared in the chaos of the Revolution, which, of course, endured its most turbulent phase in the period 1910-1920: the Pathological Institute was closed permanently during this period, and the Bacteriological Institute survived only in name. Not the least of its problems was that, following its transfer to Veracruz, the troops of Venustiano Carranza slaughtered its animals for food, although it still succeeded in producing some vaccines. Finally, in 1921, as the slow process of national reconstruction got underway, its name was replaced by Instituto Nacional de Higiene (National Institute of Hygiene), which continues to function to this day.

Diffusion in America: Brazil

As we have seen, colonial Brazil had a minimalist exposure to cultural life. It received a major boost, however, with the arrival of the Portuguese royal family in 1808, which stimulated some development in the sphere of education, and the process was accelerated rather than hampered by the definitive securing of independence in 1822. Rapid commercial expansion, particularly under British influence created the resources necessary for the establishment of some nascent institutions of higher education, including, for example, the Polytechnic Institute (Haring, 1958, p. 143-146). The country's prosperity and relative stability, as is well-known, resulted in part from the bloodless transition to independence (which stands in sharp contrast to the parallel process in Mexico) and the legitimacy of the new imperial regime, which the deposition in 1831 of Pedro I did not seriously compromise (Bethell, 1989, p. 216-217). Even in the last quarter of the nineteenth century, as debates about the abolition of slavery grew more bitter, with consequential disorder in some regions, emperor Pedro II felt able to appoint a recognised republican leader, Benjamin Constant Botelho de Magalhães, as mathematics teacher for his two nieces (Haring, 1958, p. 141). What is even more important for the purposes of this paper is that Constant was also a leading advocate of the campaign to introduce the theories and practices of Positivism into imperial Brazil, and, despite his republicanism, succeeded in persuading the emperor (like Díaz in Mexico) to surround himself with advisers committed to this cause.

By the 1880s, as economic problems caused by the price instability of coffee and sugar exports intensified, the days of the monarchy in Brazil were numbered, a point undoubtedly recognised by Pedro II himself (Fausto, 1999, p. 148-190). By this period, Mexico and Brazil had obviously evolved into very different countries, but they shared two important characteristics:

first, the admiration of their governing elites for Positivism; second, albeit at a different level, a proliferation of infectious diseases. The link between these two points validates an attempt to analyse and contrast the ways in which they responded to the assimilation of the Pasteurian paradigm, not least because there is a neat synchrony in the fact that the Instituto Bacteriológico Dr. Domingos Freire was established in the very year, 1889, of the fall of the monarchy.

In Brazil, because of the supposed discovery of the causal agent of yellow fever by José Domingos Freire, in 1889 the Chamber of Deputies considered a proposal to establish a new institution dedicated to vaccination. Some months later, Benjamin Constant, at that point Ministro da Instrucão Pública, Correios e Telégrafos (Minster of Public Instruction, Mail and Telegraphs), founded the Instituto Bacteriológico Dr. Domingos Freire. Its declared objectives were very similar to those of the Mexico's Bacteriological Institute:

> *the study of the nature, aetiology, treatment and prophylaxis of the infectious-contagious diseases and the epizooties, as well as any bacteriological research of interest to public health, including the preparation of attenuated cultures as a preventative measure against diseases, and researches into parasitism.* (Benchimol, 1995, p. 79)

At the same time, according to Jaime Benchimol,[13] José Cesario de Faria Alvim, Ministro de Justica e Negócios Interiores (Minster of Justice and Interior Affairs) authorised the publication of announcements encouraging the public to present themselves for vaccination against yellow fever. However, in 1890-1891 vaccinations had to be suspended, because Freire was sent to Berlin to study the method developed by Koch for vaccination against tuberculosis. Here we see a sharp contrast with Mexico, which looked to France, not Germany, for guidance. During the yellow fever epidemic of 1891-92, however a great number of vaccinations were given. At that point a controversy emerged: some detractors of Freire attacked his theory that the micrococcus xanthogenicus was the cause of the yellow fever. Their criticism was well-founded, as it happens, since Freire had sought inappropriately to apply Koch's terminology relating to tuberculosis to yellow fever. However, this did not emerge until later, and in the short term the controversy reflected simply the belief of powerful groups within the Brazilian medical establishment that Freire's vaccine was ineffective, because it was derived from a flimsy theoretical foundation. In the 1890s a number of rival laboratories were established in Brazil as part of a race to find a truly effective vaccine (and the rewards and prestige that would follow). The dispute came to a head in Budapest during the Congreso Internacional de Higiene y Demografía (International Congress of Hygiene and Demography), held in September 1894. Freire was invited to demonstrate his vaccine, and on his return to Brazil insisted, in the publications of his Institute, that Congress had approved it. However, shortly afterwards, Antonio de Souza Lima, President of the Academy of Medicine of Brazil, implicity contradicted Freire by calling upon the Congress to confirm its reported approval that his vaccine should become the obligatory tool against yellow fever. When the Congress declined to adopt this stance, the challenge led to the resignation of Freire from the Academy. By resigning, Freire sought to restore his credibility as a scientist, but his career was effectively drawing to a close.

In this discussion, however, there was another important ingredient, again documented by Benchimol: the young bacteriologists, operating in their own laboratories, who opposed Freire's theories were pressing, in the aftermath of the fall of the monarchy, for the creation by the government of a new institution, which make would promote professional research in place of the outdated, and highly-personalised, theories of Freire. Increasingly, they argued that Freire had done little more than restate, under the cover of a microbiological veneer, the now-oudated climatic-racial miasmatic theory developed by Darwin. In essence, Freire had insisted that climatic conditions were the most important factors explaining the origin, nature and transmission of diseases, whereas the new generation of bacteriologists rejected this outdated approach in favour of the modern insistence upon the primacy of microbes in these processes. Partly in the light of this controversy, Freire had to accept that his yellow fever vaccine was, indeed, ineffective. He was assisted in reaching this decision by the arrival in Brazil of the Italian microbiologist, Guiseppe Zanarelli – a former student of the Pasteur Institute brought to the country as part of a project to eradicate yellow fever in the city of Rio de Janeiro – who succeeded in convincing him of the error of his ways.

The ephemeral nature of Freire's institute shows that in Brazil, as in Mexico, initial optimism about the possibility of revolutionising public health and eradicating diseases by applying new ideas imported from Europe proved very difficult to translate into effective practice. In Brazil, as in the rest of the world, it would take several years to identify and isolate the causal agent of yellow fever. In the meantime, Freire, for his part, devoted more time and energy to sterile debates with his detractors than to further research (Benchimol, 1995, p. 67-98). Within a relatively short space of time this talented and well-intentioned doctor, formerly identified as a "national glory" was depicted as a "liar", and the

new republican government, aware that the creation of the Instituto Bacteriológico Dr. Domingos Freire had depended very much on the personal support of Pedro II, decided to close it. The consequential vacuum was filled to some extent by the creation in 1899 of the Casa de Oswaldo Cruz, an institution which survives until today as a pillar of Brazilian science, but it would be inaccurate to define this as a replacement. However, it is important to recognise that the closure of Freire's institute reflected political as well as scientific considerations.

Although Freire was mistaken in his argument that he had discovered the pathological agent of the yellow fever, it is important to stress that the scientific debate about the accuracy of his claims took place in the context of a major political debate about the sort of government which Brazil should adopt after the fall of the monarchy. Moreover, even when this debate had been settled with the approval of the new republican constitution (and, of course, the subsequent closure of the institute), data about the efficacy or otherwise of vaccination continued to excite fevered public debate: in 1904, for example when

> *demonstrations against the government's decision in favour of compulsory vaccination to combat the yellow fever brought together two currents of opposition: popular elements whose protests was directed largely against the high cost of living and the evacuation of those living in houses condemned as unhygienic, and military officers and cadets from military School who, while protesting against vaccination, were also levelling their sights at a higher target, namely that of the 'republic of landowners.* (Bethell, 1989, p. 291)

Thus, scientific ideas about the microbial nature of infectious diseases became were imbedded in the medical knowledge of Mexico and Brazil by means of a process that was precisely the opposite of that which occurred in the central countries (France and Germany, in this particular case). In the latter the scientific facts emerged first and subsequently the scientific community accepted the task of systematising them and shaping them into an organised group of ideas which would govern the discipline in the future. In the peripheral countries, by contrast, the ideas arrive first and, once they had been discussed and assimilated by the local scientific communities, slowly become part of local scientific practice. This is precisely what occurred in the late-nineteenth century, and it has continued throughout the twentieth and into the twenty-first (Glick, 1995).

Before proceeding to suggest some conclusions, it is worth noting that, whereas Mexico never established a Pasteur Institute, Brazil eventually created several: at Recife (1899), São Paulo (1903) Juiz de Fora (1908) Porto Alegre (1910) and Santa Catarina (1912) (Ribeiro, 1997, p. 67-98).

Preliminary Conclusions

In this paper we have analysed two early attempts to institutionalise microbiology in the American Continent. It is clear that the strong belief in the efficacy Positivism in holding out the prospect of a promising future was the principal motor determining the policies of the respective governments in this as in other spheres of activity (Bakewell, 1998, p. 319-372). The academic elites formed by this ideology were also key elements in the encouraging of this process. However, for different reasons, both institutions studied – The Freire Institute in Brazil and the Bacteriological Institute in Mexico – saw their development come to a halt, and it would not be until the early-twentieth century that both countries managed to institutionalise and consolidate their institutions of microbiological research, despite the urgency of finding solutions to the major problems of public health caused by the serious epidemics that continually devasted their populations.

Some significant questions require further investigation to enable us to understand and explain the reasons for the delay in consolidating these institutions. In the case of Mexico, it is already obvious that the outbreak in 1910 of the Revolution, and the political instability that came in its train, was the most important reason for the collapse of an Institute that had had some success in dealing with the problem of infectious diseases.[14] Another was the sudden departure of Girard in 1913 – it is not clear if he was dismissed or resigned – because of "personal problems" with Gaviño.[15] The importance of the contribution of Girard to the development of bacteriological knowledge in Mexico is undeniable, and once he had gone the growth of the Bacteriological Institute was curtailed. The real root of the dispute between Gaviño and Girard remains a matter for speculation. However, in the light of the point made in this paper about the French government's programme for mapping the diseases of the world, it has been suggested that Girard was very active in informing Nicolle of the results of his experiments (Priego, no prelo). This theme will be explored in more detail in a separate paper, currently in preparation.

In the Brazilian case, a similar situation occurred. The criticisms of the Freire initiative were so corrosive that public opinion was distracted from the real issue of how to combat the yellow fever which had been a perpetual cause of suffering in the region. Here, as in Mexico, the lack of cohesion and leadership within the local scientific communities, coupled with a kind of innocence (or ignorance) at governmental level persuaded those involved that the apparent discovery of a vaccine for yellow fever would eventually bring into being the

orderly, rational world predicted by Positivist theory. Obviously, they were mistaken.

Chance, wars, internal fights, cacicazgos, and personalism, are well-known characteristics of the history of Latin America and there is no doubt that science is a part of this history, a part of human experience which is neither transferable nor transplantable. However, it is possible to make adaptations to different realities and, thereby, this knowledge acquires a new dynamic in and from the new scenario. The new scenario not only modifies its former reality but at the same time it modifies itself, assimilating the new paradigm. However, this is a process which takes time, since it involves the fusion of local and foreign visions of the same problem.

The similarities and differences in the ways in which these two post-colonial countries responded to attempts to foster the growth of the new science of the late-nineteenth century lead us to the conclusion that their so-called "backwardness" or "underdevelopment" was (and is) present in not only the economic and industrial landscape but also in the cultural and social. It is also possible to suggest that we are dealing with different cultures and contexts, in which the race to "catch up" with the countries that define themselves as "developed" will be endless, given that peripheral science needs to be defined for what it is, not what it is not. In other words, as long as these countries continue to view themselves in terms of their "otherness" with respect to the hegemonic centres of science, they will always remain in the rearguard, continuously trying in vain to be like the others.

Notas

[1] Much has been written about Louis Pasteur's life and works. The following works are good examples: Martínez Báez, 1995; Lambrichis, 1995/1996, p. 7-30.

[2] Pasteur's works were published in *Botanical Journal*. This journal was edited by Ferdinand Cohn, a colleague of Koch, in Breslau University.

[3] Archivo Histórico de la Escuela de Medicina-Universidad Nacional Autónoma de México (thereafter cited as AHEM-UNAM) Leg. 152, Exp. 22, Fo. 1, 1887.

[4] Eduardo Liceaga was born in 1839 into a rich family in Guanajuato, Mexico. He studied medicine in the National School of Medicine and received his certificate in 1866. He was a founder of the Sociedad Filarmónica Mexicana (Mexican Philharmonic Society), the General Hospital (where he taught) and the Academia Nacional de Medicina (National Academy of Medicine). He was also prominent as a promoter of the public hygiene. He died in Mexico City, in 1920.

[5] See Zea, Leopoldo, *El Positivismo en México. Nacimiento, Apogeo y Decadencia*, México: FCE, 1968. Also Comte, August, *La Filosofía Positiva*. México: Porrúa, 1980.

[6] AHEM-UNAM, Leg. 260, Exp. 13, Fo. 7, 1888.

[7] AHEM-UNAM, Leg. 284, Exp. 8, Fo. 8, 1912.

[8] AHEM-UNAM, Exp. 29, Leg. 49, Tomo 6, Fojas del tomo 561, 1889.

[9] See Saldaña, Juan José and Priego, Natalia. "Entrenando a los cazadores de microbios de la República: la domesticación de la microbiología en México". *Quipu. Revista Latinoamericana de Historia de la Ciencia y la Tecnología*, vol. 13, n. 2, México, p. 225-242, Mayo-agosto de 2000.

[10] Archivo Histórico del Centro Médico Nacional-Fondo Academia Nacional de Medicina, *Boletín del Instituto Patológico*, Tomo III, marzo-octubre de 1905, meeting of October 13, 1905.

[11] About details over this controversy, see Priego, Natalia, "El piojo, inocente o culpable? Una controversia científica en el porfiriato", *Horizontes*, Brazil, en prensa.

[12] Archivo General de la Nación-Fondo Secretaría de Justicia e Instrucción Pública (thereafter cited as AGN-FSJIP), vol. 139, Exp. 11, Fos. 11-13, 1906.

[13] Ibidem, p. 79 onwards.

[14] Archivo General de la Nación-Fondo Secretaría de Instrucción Pública y Bellas Artes (thereafter cited as AGN-FSIPBA), Caja 141, Exp. 20, Fos. 1-6, 1910.

[15] AGN-FSIPBA, Vol. 139, Exp. 26, Fos. 1-3, 1913.

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