Chapter 10
Co-producing Social Problems and Scientific Knowledge. Chagas Disease and the Dynamics of Research Fields in Latin America

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10.1 Introduction

How can we analyze the relationship between the practices of scientific knowledge production and the emergence and solution of social problems? How can we explain the bridge – or the gap – between apparently very 'local' social issues and global scientific research? What are the particular features of these processes in Latin America, considered as a 'peripheral region'? In this paper I will analyze these relationships by highlighting the following aspects involved: the public theming and articulation of social problems, the strategies for 'mobilizing' scientific knowledge as a way to address these problems, and the role of scientific knowledge itself in the definition of public discourse and policies. These issues are necessarily accompanied by others: the local history of research traditions in different scientific fields, the tensions between social uses of knowledge, and the relationships with the international scientific mainstream.

To explore these questions I will consider a specific case: the coproduction of Chagas disease as both a scientific and a public problem during the twentieth century in Argentina. The question is of particular interest because the disease only exists in Latin America and because it has been a relevant scientific subject in several research fields.

The shaping of 'modern' research traditions in Latin America cannot be analyzed separately from the international dimensions of each scientific field (Kreimer 2010a). The visits of European researchers (and later also those from North America) were followed by the Latin American pioneers' own visits to the most important international research centers. Thus, for instance, the Pasteurian tradition

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became crucial to the development of microbiology in Brazil (Stepan 1981; Lima and Marchand 2005; Cukierman 2007) while the German influence was formative for the early development of physics in Argentina (Pyenson 1985).[1]

The development of science in the period following its institutionalization (the first decades of the twentieth century) has been marked, in the more advanced countries of Latin America, by a tension that remains effective until today: On the one hand, science in Latin America has been – and still is – configured by the imitation respectively transfer of the dominant trends from advanced countries, as concerns both the organization of research systems and specific research lines (Oteiza 1992). Indeed, this international dimension played a crucial role, from the 'liberal internationalization' of research at the beginning of the twentieth century to 'mega-science', characterized by huge networks and a new international division of scientific work, at the beginning of the twenty-first century (Kreimer 2010a).

On the other hand, the production and application of scientific knowledge has been actively proposed as a rightful method of intervention in social issues, and therefore forms the foundation for the legitimation of science policies. Indeed, since the 1960s, Latin American States have developed several instruments for the promotion and steering of scientific practice as a 'national' concern. This process has been guided by a well-known 'linear-liberal' conception, according to which the *offer* of knowledge is expected to generate benefits to society as a whole through a set of social mediation mechanisms (that were, however, never seriously attempted to be made explicit). This trend was followed by a 'linear-oriented' policy rooted in the concept of *relevance*. Heavily influenced by European models, the underlying concept underwent a change from a *naïve* view of the usefulness of science to the notion that social problems could be addressed – and even solved – through scientific knowledge. While, in the first model, it was left to the scientists to define what counts as 'relevant', the State itself defines the problems as such in the second model.

While the orientation toward local problems did not generate major conflicts in fields such as nuclear physics, it caused international marginalization in many other fields as scientists generated knowledge of little interest to the global mainstream.[2] Although various public concerns and scientific problems were co-produced throughout history, stimulated by public policies, this tension has been generally resolved in the emergence of an increasingly 'globalized local science'. The orientation towards local problems may reconfigure some scientific fields locally but, for science, this process ultimately remains a rhetorical operation.

[1] Cukierman (2007) uses the term "disembarked science" to characterize the early period of Brazilian microbiology.

[2] Nuclear physics is a particular case, both in Argentina and Brazil, because research and production (of energy) have been traditionally close while the connection with the field's international mainstream has been strengthened over time. See Hurtado de Mendoza (2005) for the Argentinean case and Velho and Pessoa (1998) for the Brazilian one.

Yet, scientists who dominated the diverse research fields have not been passive receptors of such local policies; they actively intervened in at least three ways:

1. As policy makers (typically, prestigious researchers have acted as the highest authorities of national research councils since their creation in the 1950s), they promoted, as 'relevant' topics and approaches, the research lines conducted by the dominant scientific elites in each field.
2. As promoters of public issues, they reformulated these issues as knowledge problems, addressing several actors and particularly the State.
3. Finally, they intervened in policy by producing knowledge whose legitimacy is rooted in its 'applicable' nature while, at the same time, moving the responsibility of its application to the local context, the market or other actors. This particular process has been analyzed in terms of 'applicable knowledge not applied' (Kreimer and Thomas 2006).

In her analysis of some of these issues, Jasanoff (1990) has distinguished a 'democratic' paradigm, associated with the advice to parliaments to implement a science 'for the People', and a 'technocratic' one, associated with regulatory science. In Latin America, the democratic paradigm has been traditionally weak, with the relationships between scientists and members of parliament being historically rather interpersonal – due to membership in the same socio-economic elite – than institutional. On the contrary, regulatory science has been deployed with growing impetus from the 1980s until today, accompanying the rise of new social and scientific issues, like biotech crops or environmental issues (Da Silveira et al. 2009; Burachik and Traynor 2002).[3]

Following the 'idiom of co-production' (Jasanoff 2004), I will show in this chapter how the joint constructions of scientific knowledge and social problems operate in a complex and polymorphic way by presenting selected episodes from the history of Chagas disease in Argentina (and to some extent in other Latin American countries).

10.2 The Co-production of Chagas Disease as a Public and Scientific Problem and the Emergence of New Research Fields

In the context of the pursued research questions, Chagas disease is a particularly interesting case, for a number of reasons:

- It is the only disease that exists in no other region than Latin America.
- It is a 'non transversal' disease with the affected population (and the population at risk) being exclusively composed of poor rural people (unlike e.g. AIDS or

[3] In some selected fields, such as public health and nuclear research, this paradigm has been in practice since the 1950s.

cardiovascular affections). More than 18 million people are infected throughout almost all Latin American countries (WHO/TDR 2005).
- For more than a century, it has been an object of research in various successive scientific fields and co-produced with several social problems.
- It has been addressed by diverse public policies (including S&T policies) that implied the reconfiguration of scientific fields.
- Today, it is considered a 'neglected disease' while there is – still – no entirely effective treatment or prevention (DNDi 2006).

I will focus on three significant phases in the history of Chagas disease since the early twentieth century. The first phase (1910–1940) is characterized by its recognition as a specific disease by medical doctors and bacteriologists at a time in which it remains confined to a small group of infected individuals who were poor and lived in rural areas. As concerns the second stage (1940–1960), we discuss its public irruption, the institutional arrangements and control practices of the Federal State, alongside the emergence of epidemiology as a 'State discipline' (Plotkin and Zimmermann 2012), linked to the modern emergence of public health policies (including the creation of the Ministry of Health). For the third phase (from the 1970s), we focus on the time of major scientific production in relation to the disease, associated with the emergence of molecular biology and the promise of vaccine development.

10.2.1 Phase 1: From Invisibility to Visibility, the Construction of the Disease

The first step towards the construction of Chagas disease as a public problem concerned its identification *as a disease*, that is to say, as an object of study recognized by the scientific-medical community. This construction was not straightforward but, instead, surrounded by multiple controversies concerning the symptoms of the disease, the parasite's ability to infect, the validity of diagnostic methods for its recognition, and, as a consequence, its territorial extension.

In 1909, the medical doctor Carlos Chagas announced in Rio de Janeiro (Brazil) that he had discovered a new biological entity: an unknown parasite, which he dubbed 'Trypanosoma cruzi', with 'cruzi' honoring Oswaldo Cruz, a disciple of Pasteur and the founder of the institute at which Carlos Chagas was working.[4] Interestingly, this was the reverse of the usual process. In a boom of microbiology and bacteriology, researchers were launched 'to hunt parasites' (Worboys 1993) that would account for many already known diseases. Usually, this process targeted 'international' diseases, like tuberculosis and smallpox. Instead, Chagas had first

[4] The 'Federal Serum Therapy Institute' was created by the young microbiologist Oswaldo Cruz in Rio de Janeiro with the aim to develop a vaccine against the bubonic plague. Created in 1900, it was officially named 'Instituto Oswaldo Cruz' in 1908 (Kropf 2009).

found the 'causal agent', onto which he then had to 'foist' a disease, as yet unknown in developed countries, and invisible to (i.e. unidentified by) Latin American researchers. Indeed, Latin American populations had been carriers of the parasite for centuries and some recent texts even suggest that already the Inca mummies had been infected (Fornaciari et al. 1992). But until the early twentieth century, it had remained an invisible entity that sickened and killed without having a name and, therefore, a complete existence.[5]

Chagas started a process that gave a certain visibility to this new disease, defining it in relation to the existence of the parasite, a vector that transmits it (a triatomine insect called 'vinchuca' in Argentina, 'barbeiro' in Brazil, 'pito' in Colombia and Venezuela) and, especially, establishing a set of physical symptoms. However, the process did not occur in a linear way since microbiologists from Rio de Janeiro proposed a close relationship between the presence of the parasite in the blood and the symptoms of goiter, which was a well-known disease. To 'stabilize Chagas disease' (Zabala 2010) as a new medical entity, the work of two European bacteriologists, the Austrian Rudolf Kraus and the French Charles Nicolle, as well as of the Argentine physician Salvador Mazza who was based in northern Argentina was crucial. The connections with important representatives of the international scientific community, far from being a mere coincidence, are a constitutive element of these processes, their form having evolved over the last century.

Kraus had arrived in Buenos Aires in 1916 to head the new Institute of Bacteriology (IB). Nicolle, who had been the director of the Pasteur Institute in Tunis from 1903 until his death in 1936, came to Argentina in 1925 for a short mission being particularly interested in tropical diseases. At that time, Mazza held a professorship of bacteriology at the University of Buenos Aires. He had met Nicolle in Tunis during a scientific visit some years earlier.

In the 1930s, Mazza headed the organization of the *Mission of Studies for Argentinean Regional Pathologies* (MEPRA in Spanish), an institutional space almost exclusively devoted to studying Chagas disease. The Mission had settled in Jujuy, in the north of the country close to Bolivia (more than 1500 km from Buenos Aires), in an area with a high prevalence of infected people. Mazza and his collaborators had the support of both Kraus, from the Bacteriological Institute, and Nicolle, who developed the most advanced diagnostic methods at the time.

Despite this joint effort, the identification of infected people, which was crucial for determining the existence of the disease, remained a difficult task. Mazza and his team argued that the (assumed) symptoms then attributed to Chagas disease (goiter and cretinism) were not observed in those people whom they had successfully identified to be infected. Mazza developed a research strategy oriented towards the identification of the acute cases, derived from the patients' clinical diagnosis. He carried out three simultaneous conceptual moves through his investigations that were of central importance to the co-production of Chagas as both a social and a scientific problem.

[5] It may be interesting to stress a parallel with Latour's text (2000) on Pharaoh Ramses II and his alleged death of tuberculosis, i.e. caused by Koch's bacillus.

First, Mazza appeals to a rhetoric in which the existence of the disease appears as 'naturalized' and in which its lack of identification is associated with a lack of medical competence and technical skills.

Second, he reconfigures the clinical characteristics of the disease: from being associated with debilitating pathologies such as goiter and cretinism to a group of symptoms of less severity. This reconfiguration is central for two reasons. On the one hand, Mazza aims to refute the argument that 'pure forms' of the disease cannot be observed because the investigations were conducted in a region where goiter and malaria were not found. On the other hand, he attempts to settle a central aspect of the disease: to break the association with goiter and to establish the 'real' clinical symptoms of Chagas disease.

Third, Mazza presents a way to identify the parasite by standardizing a current procedure. This procedure includes a strategy to combine methods belonging to different knowledge fields: 'blood big drop analysis' to macro-biological analysis, 'Machado's Technique' to clinical research, and 'Xeno-diagnosis' to biochemistry (Mazza 1939: 134).

Indeed, the process of constructing Chagas disease as a scientific object was closely linked to the institutionalization and development of various scientific fields, which were growing in those years, such as the following.

Bacteriology was gaining increasing visibility as an autonomous discipline, both in Brazil and Argentina, and it found, in research on Trypanosoma cruzi, a privileged object of observation. At the same time, the Institute of Bacteriology in Buenos Aires became a decisive site for the development of biomedical research with key figures such as Alberto Sordelli (a Kraus disciple) who was considered the founder of biochemistry in Argentina; Bernardo Houssay, a physiologist awarded with the Nobel Prize in Medicine in 1947; and his disciple Luis Leloir, Nobel Prize winner in 1970 (Kreimer 2010b).

Tropical medicine developed in parallel: while it was already an established field in Brazil, the creation of the MEPRA constituted the first systematic program in Argentina.

Finally, *zoologists and entomologists* attempted to understand, shortly after Mazza's investigations (human centered and secondarily focused on the parasites), the mechanisms associated with the vector (an insect, a triatomine) which lives in the interstices of poor rural households.

To summarize, the first movement of the articulation between scientific development and the social order occurred through the constitution of a human-centered perspective, by establishing a new social category nonexistent until then: people suffering from Chagas disease.

10.2.2 Phase 2: From Linear to Exponential Growth, from Private to Public Problem

In the early 1940s, local scientific-medical communities, in both Argentina and Brazil, had recognized the existence of Chagas disease. As aforementioned, bacteriologists, entomologists, biochemists, and medical doctors were conducting research on the new disease, on the characteristics of sick people, and on the conditions of transmission from insects to humans. It had been established that one of the most important physical consequences of Chagas was a particular cardiac pathology, and this meant that cardiology became the main medical specialty.

Yet, the logic prevailing until then was centered on individuals (sick people), and it was not until the late 1940s to mid-1950s that Chagas disease became recognized as a social problem of 'national' relevance. We have to consider, both, the *rhetorical use* of scientific knowledge in the public arena with an interest in how the arguments about the disease were transformed into public policy and the question of how Chagas research changed at that same time.

In terms of scientific knowledge, two conceptual moves were crucial. They modified, at the same time, how the disease was thought about and which types of actions were deployed in connection to it. The first move has already been mentioned: the establishment of Chagas as an autonomous disease by detaching it from its association with goiter or cretinism. The second step was the inference of the affected population by means of statistical estimations that exponentially increased the number of *presumed sick people*. The principal source of argumentation of both transformations came from work by Cecilio Romaña, a medical doctor who had worked with Mazza at MEPRA. He later moved to the Institute of Regional Medicine at the University of Tucumán (IMR), located in the core of the Chagas endemic area in Northern Argentina.

At the IMR, Romaña worked to produce the necessary evidence to make public health concerns known: he presented the clinical histories of 35 patients with a symptomatic chart of myocarditis (heart injury variations) and a positive reaction to laboratory tests for infection of *Trypanosoma cruzi*, using the reaction of complement fixation (Romaña and Cossio 1944).[6]

Romaña's strategy was clearly defined by the demonstration of the epidemiological importance of the disease, associated with the existence of chronic patients, even if he had to apply more heterodox research methods. The research was carried out in different stages, analyzing students of rural schools in four towns. In total around 600 cases were considered, with an infection rate of around 20 %. Even if the population under study was severely reduced in number in comparison with

[6]The 'chronic cardiac form' has imprecise clinical manifestations, some of which included the enlargement of the heart, heart palpitations, partial or total obstructions (that were manifested in skips in the heartbeat and by electrocardiograms). Nevertheless, these symptoms were not repeated in all the patients, and the diagnosis as 'chronic Chagas disease' could only be "presumed, [while] the etiological diagnosis corresponded to the laboratories' (results)" (Zabala 2010: 143).

similar studies, Romaña allocated great importance to these results, claiming that they constituted a demonstration of Chagas' epidemiological distribution. To do so, he made a substantial methodological leap in establishing the amount of infected people: instead of calculating the number affected as the result of the sum of identified infected persons (acute or chronic), Romaña proposed to extrapolate these figures to the rest of the population living in similar conditions (calculated at 3.5 million people). Based on this calculation, the figure of infected people went from 1,400 cases to one million (Romaña 1953).

Thus, during the 1950s, we observe a fundamental shift in the scientific construction of Chagas disease that engendered effects surpassing the domain of science: *from the study of sick people to the indiscriminate study of the population*.

This process involved, on the one hand, an appropriation of the scientific rhetoric by political actors and, on the other, an appropriation of the political concerns and a social justification by medical doctors and researchers. At this point, another key contextual element must be considered. In 1945, Juan Perón had become president, which marked the onset of a new political, markedly populist regime.[7] Under the Peronist regime one significant change of policies concerned the health system: the new policies had a strong emphasis on hygiene, the fight against infectious agents, and bringing about access to healthcare among marginalized sectors of the population. This policy is coherent with the social basis of Peronism, especially the working class and rural people, marginalized from the political arena until then.[8]

In 1949, Perón created the Ministry of Health and appointed Ramon Carrillo, a medical doctor specialized in 'social medicine', as Minister. Carrillo struck up a close relationship with Romaña. He came from Santiago del Estero, another northern province with a strong prominence of Chagas disease. Both shared the – then relatively new – idea of a 'social medicine' and an attachment to the Peronist regime. In this context, Carrillo elevated Chagas disease to the status of a 'national problem' and quickly adopted Romaña's rhetoric.

The political recognition of the importance of Chagas disease entailed an institutional development of the fight against it. Another crucial transformation in the conception of the disease was associated with a scientific-technological advancement that had occurred during these years: the use of *gammexane*, a new insecticide. Thus, while the only solution to limit Chagas disease envisioned since the mid-1940s had been to modify patterns of rural housing, a new insecticide would give other tools. When the efficiency of gammexane in eliminating the *vinchucas* of the rural houses or 'ranchos' was demonstrated, fumigation was introduced as the principal means of intervention. Thus, the programs set out by the Minister of Health

[7] For another illustration of how a political regime affects the configuration of research fields, see García-Sancho's (Chap. 12) study of the development of protein sequencing in Spanish biomedical research.

[8] Since the end of the nineteenth century and until 1945, Argentina had a sequence of governments that represented the economic elite (conservative parties) or the middle class (radical party). The workers, until then socialists, communists or anarchists, turned into one of Perón's strongest constituencies.

were principally oriented towards drawing up a plan for mass housing fumigations.

Those times were also marked by the growth and diversification of the Latin American scientific community devoted to Chagas disease. Cardiologists were in charge of the treatment of infected people. Their clinical research were experiencing an important shift through the availability of a new technological device, the electrocardiograph, which was employed for the first time by Mauricio Rosenbaum to identify Chagas infected people in 1950 (Rosembaum and Alvarez 1955). In addition, a new specialty entered the scene: *epidemiology*. Its practices were oriented towards mapping the prevalence of the disease, establishing the geographical scope and, above all, the number and distribution of the infected people. The new methods used by Rosenbaum were combined with epidemiological surveys to determine the number of infected people in a more accurate manner than the techniques employed by Romaña. Furthermore, *chemical* research began to play an important role in the pursuit of effective insecticides for the spraying of rural households. I will discuss next, how the development of new scientific fields and, therefore, the overlapping perspectives on the disease made the co-production process increasingly complex.

10.2.3 Phase 3: Production of a Vaccine Against Chagas Disease, or the Construction of Fictions Beyond Laboratories

Institutional manifestations of support for research on Chagas disease were numerous. An example is the creation, in 1965, of the Commission of Scientific Investigations on Chagas at the University of Buenos Aires with research in biochemistry, microbiology, and clinical medicine. Even more important was the creation, in 1974, of the National Program of Research on Endemic Diseases by the national Secretary of Science and Technology. At the international level, these initiatives had been accompanied by the creation, in 1975, of the Special Program of Research and Training in Tropical Diseases (TDR) of the World Health Organization (WHO). These institutions provided fundamental support for the consolidation of scientific research on Chagas disease.

Those years also witnessed an important cognitive displacement, right in the heart of the biochemical research tradition. In Argentina, the emergence of *molecular biology* challenged the historical domination of the biomedical field by physiologists and biochemists, led by the abovementioned Nobel Prize winners Houssay and Leloir.

The first laboratories devoted to molecular biology were established in 1957, assembling two of the three international traditions within this field: the British or ‘structural’ and the French or ‘biochemical’ tradition (there was no influence of the

American or 'informational' tradition).[9] The head was the young chemist Cesar Milstein (Kreimer 2010b). However, only 5 years later, these labs were dismantled by a political irruption (the military coup that ousted President Frondizi), forcing most of the researchers into emigration. Milstein moved to MRC Labs in Cambridge (UK) where he worked closely with Fred Sanger; he was awarded the Nobel Prize in 1984 for his work on monoclonal antibodies (Kreimer and Lugones 2003).

After a 'dark' period between 1962 and the mid-1970s, research on molecular biology re-emerged in the core of the old biochemistry domain, the Campomar Foundation, in Buenos Aires (the institute created by Leloir in 1947), with a particular feature: T. cruzi was the first object that the molecular biologists focused on. This development began with the first disciples of Leloir returning to Argentina (after their post doctorates abroad) in the second half of the 1970s to study the different biological mechanisms associated with the genetic regulation and expression of T. cruzi.

Molecular biology was born as a new field 'from the bowels' of the old biochemical tradition and in the same institution. Moreover, from the fact that the first molecular biologists focused on T. cruzi as the main object one can infer that 'modern' research on Chagas disease and on molecular biology were mutually coproduced in Argentina from the 1970s onward. An illustrative episode shows the tensions between 'tradition' and 'innovation' at that time: When Milstein was forced to resign from his position as director of the first molecular biology laboratory in 1962, he asked Leloir to receive him in his extended institute. Leloir refused, arguing that "molecular biology is just a set of biochemistry's ancillary techniques" (quoted in Kreimer 2010b). A decade later, most of his disciples were retraining in these 'new techniques' and partially abandoned biochemistry.

This development implied yet another shift of the research focus on Chagas disease: this time from infected people (and transmission mechanisms) to the parasite T. cruzi. Thus, all aspects related to the physiology of the parasite and the host (humans and animals) became deeply investigated. The stated objective was twofold: on the one hand, to find a target to attack the parasite, which would allow the production of an efficient drug; and on the other hand, the study of antibodies that would respond to the parasite to obtain a vaccine. This last objective was particularly important, as it was accompanied by the promise of a 'radical solution' to the social problem: if a vaccine were available, the other means of public policy (such as systematic fumigation of the 'ranchos' or the search for new treatments) could be abandoned.

The irruption of molecular research on T. cruzi, and especially the 'promise' of a vaccine or a new (and effective) drug, led to a new political approach to face Chagas disease as a public problem. This change was simultaneous with the implementation of a new set of S&T policies, imported from more advanced countries and based

[9] Cf. Rheinberger (Chap. 11) for a history of molecular biology with a focus on national vs. international dynamics. See also Stent (1968), Gaudillière (1996), Abir-Am (2000), among others.

upon the idea that defining and stimulating 'relevant knowledge' was the key to achieve a transfer from 'academic research' to social and economic goals. As a consequence, several funding programs were promoted to encourage research on Chagas disease. As molecular biologists were the most prestigious group (compared to entomologists, biochemists, medical doctors or chemists, associated with 'old fashioned research'), they won the 'jackpot' of public funds since the 1980s.

From the 1980s on, we observe a significant production of scientific studies related to Chagas disease whose importance can be assessed from the results of our earlier bibliometric analysis (Kreimer and Zabala 2007)[10]: Between 1995 and 2005, *1,650 papers* were published in international journals. A majority of authors are affiliated with CONICET (National Research Council) laboratories while also a few public universities (Buenos Aires, Córdoba, Rosario) are well represented.

The distribution of research themes shows a strong concentration (49 %) of research in molecular biology and biochemistry, focused on T. cruzi. Consistent with political discourse, the declared goal of many research teams is the production of knowledge needed for the development of new drugs (in particular, the search for "targets" within the DNA sequence to attack the parasite).[11] Nevertheless, the utility promised by the scientists is reduced to a mere rhetorical construction by both scientists and politicians, as it hides the fact that the responsibility of developing new drugs is held by *other* social actors (pharmaceutical industry) that have not shown any interest in the issue (among other reasons, because there is a regionally restricted market, mainly composed of poor people). In fact, there were hardly any links between the research teams conducting analytical research and the producers of drugs.[12]

From the perspective of policy makers, the large number of publications is considered a great success: An impressive amount of 'relevant' scientific knowledge has been produced and published according to an international standard of 'quality', i.e. in journals with a high impact factor. Furthermore, approximately a third of these articles have been co-authored with scholars located in industrialized countries.[13] Policy makers consider that this 'stock' of knowledge should serve as a starting point for a transfer process that ends with a new vaccine or a new drug available to sick people in the pharmacies.

[10] See Kreimer and Zabala (2007) for the procedure and methodological reflections underlying this study.

[11] The search for a vaccine was abandoned by almost every research group during the 1980s, as it became evident that it was very difficult to achieve due to technical restrictions.

[12] This situation partially changed in recent years, thanks to the establishment, in Latin America (Rio de Janeiro, Brazil), of a DNDi office (Drugs for Neglected Disease initiative, a NGO very close to the WHO) which explicitly encourages drug development instead of basic or applied research.

[13] Some STS-scholars seem to share this optimistic view: they observe a 'success story', showing that scientists working on Chagas disease "tackle relevant issues, share values and procedures with *core loci* representatives, and take part in heated controversies: in short, they participate in the construction of legitimate science" (Coutinho 1999: 519).

Research targeting infected people amounts to 24 % of the scientific production. However, clinical investigation (included in this category) aimed at knowledge that can be incorporated into clinical practices constitutes only a very small fraction of research output. It is carried out in poorer institutional conditions, regarding both financial resources and professional recognition. Indeed, cardiologists focusing on Chagas have significantly lower prestige within their field than the colleagues that work on 'global' diseases, like e.g. cardio-vascular risks factors. When taking into consideration the distribution of symbolic capital (in Bourdieu's terms) across the various scientific fields (both in Argentina and Brazil), it is evident that the structure of local scientific fields is crucial to account for the uneven capacities of social actors to transform a social problem into a scientific research object and vice versa, re-signifying it according to their interest, practices, and possibilities. Thus, the relative power held by molecular biologists allowed them to impose their views, establishing a *de facto* alliance with policy makers resulting in a mutual process of legitimation.

10.2.4 Phases 4 and 5: Purification and Internationalization of T. Cruzi

To fully understand the importance of the cognitive displacement that occurred since the 1980s the two below facts have to be taken into account.

First, the T. cruzi is an important *biological model*. This feature has consequences both for the socio-cognitive development of the research teams that focus on it and for the possibility of obtaining complete DNA sequences of an easily manipulated entity (and the original processes that can be observed). Indeed, the complete sequence of the T. cruzi genome has been obtained in 2005 thanks to the 'Trypanosoma cruzi Genome Project', conducted by a consortium of more than 50 laboratories and brought together by the two international agencies WHO/TDR and CYTED (Ibero-American Research Funding Agency). According to an Argentinean researcher, "The TcGP is an important tool for the study of Chagas disease. It provides researchers and clinicians with information about expressed parasite genes and with an important number of genomic libraries and probes" (Levin 1999). While Latin American molecular biologists effectively took part in the consortium, it was not headed by any of them, but by two scientific groups located at The Seattle Biomedical Research Institute in USA and Uppsala University in Sweden.[14]

Second, the *peripheral condition* of elite Latin American researchers is of importance. Within countries such as Argentina, Brazil or Colombia, molecular biologists are considered very prestigious. These scientists tend to have strong links with

[14] The main results have been published in a paper signed by around 50 authors, including several Latin American molecular biologists (El-Sayed et al. 2005).

colleagues in 'developed' countries, constituting a relation of 'subordinated integration' (Kreimer 1998). On the one hand, they are effectively integrated in international scientific networks: they take part in projects and international research programs, regularly attend conferences, handle data that enables them to steer their research in several directions, and have access to international grants. The groups most strongly integrated in international networks are typically, at the same time, the most prestigious ones in the local institutions. The local scientific elite has the power to determine the orientation of research at both the level of institutions (policies) and of informal interventions, which influence agendas, the main lines of research and the selected methods. But on the other hand, and as a direct result of their specific form of interaction with mainstream science, the groups with the strongest international networks tend to carry out 'mere' routine activities: controls, trials, and tests on knowledge already well-established by the teams that take on the coordination in these networks.[15] This feature has important consequences for 'peripheral science': research agendas are often defined within 'central' groups and then become adopted by 'satellite teams' as a necessary condition of a complementary style of integration.

Indeed, in recent years, an increasing number of Latin American molecular biologists take part in international networks and projects, funded by international agencies such as NIH, WHO, The Howard Hughes Medical Institute, and the European Union. To be sure, this participation does not only depend on the preferences of Latin American researchers. It also suits the interests of the more advanced regions, which promote an active enrolment in the large networks of scientists coming from developing countries with strong scientific traditions.[16]

10.3 Conclusion: Scientific Success and Social Failure

In this text I have shown that the establishment of Chagas disease as both a scientific and a social entity resulted from the strategies of different actors over several decades: bacteriologists and medical doctors in a first phase; epidemiologists, entomologists, cardiologists, and chemists in a second phase; and biochemists and molecular biologists in a third phase. These actors established distinct alliances with various political regimes and S&T policy makers.

During the whole period, the associations with scientists and groups located 'in the center' have been crucial to understanding the local dynamics: from the 'Pasteurian' tradition in Brazil and the influence of French and German experts in Argentina to the active participation of molecular biologists in modern international

[15] For an analysis of the unequal distribution of tasks inside international scientific networks, see Kreimer and Levin (forthcoming).

[16] For instance, we recently showed that the added contribution of Brazilian, Argentinean, and Mexican participation in European projects is equal to the sum of French and German teams (Kreimer and Levin 2013).

networks. The scientists also interact with other actors. In the case of Chagas disease, the 'facts' taken as valid depended on certain circumstances: the introduction of new disciplines, such as epidemiology and cardiology, the development of new insecticides, and a particular configuration of the health system were all important. However, it is not sufficient that knowledge is accepted as valid in the academic field for it to be introduced into a public policy field, as one might claim with Bourdieu (1997). Scientific knowledge functions as a particular form of rhetoric and serves to legitimate the processes of policy making even in cases in which it is not completely accepted within the scientific field (Collins and Evans 2002). Conversely, the fact that a given problem is posed in the public arena can mobilize research fields and even cause struggles between diverse disciplines on what constitutes accurate and useful knowledge.

However, there is an absent actor throughout this story: the sick people and the population at risk. These rural poor people, living in small towns, usually don't know that they are infected. Indeed, they have no voice, but they have spokespeople who speak 'on their behalf': medical doctors, politicians, entomologists, anthropologists, molecular biologists, etc.

This absence is the consequence of a *purification* (Knorr-Cetina 1981; Gusfield 1981) of the parasites. They are taken as objects of knowledge detached from all social groups: from the 'ranchos', from the 'vinchucas', and particularly from the infected people. They are *isolated* into gene sequences, in libraries of protein splicing or in socio-technical devices for the construction of analogies with other biological mechanisms. In this context, a slight call to reality is made by physicians – usually cardiologists – when they complain that molecular biologists only use medical doctors as providers of a prized good: blood infected with T. cruzi. The physicians are obligated to negotiate with the biologists, because in exchange for the blood – that will later be an object of purification – they obtain the PCR analysis (polymerase chain reaction) that allows them to carry out diagnoses that are more precise and contain more information. Actually, what they are pointing at with their complaints is how Chagas disease, as an object, has been re-signified (from the ranchos and infected people to the DNA sequence in a lab) by a set of actors that had the capacity to publicly impose both a new meaning and the means of intervention. This is accompanied by the high social prestige gained by molecular biologists, as opposed to the relative depreciation of cardiologists specialized in Chagas disease.

Once the parasite has been detached from its social environment, it plays an additional role: it is reduced to a DNA sequence that scientists can easily handle, transform, and communicate via internet, and therefore negotiate with the leaders of 'mainstream' research centers working on basic or applied research in molecular biology (not necessarily related to Chagas disease). They 'offer' the parasite DNA as a raw material to participate in large international networks whose results may be used (industrialized) in a context that gives industrial facilities (advanced countries).[17]

[17] For a scheme of this process, see Fig. 10.1 at the end of this chapter.

As a consequence of this process, Chagas-oriented research serves the scientists to legitimate their research in terms of its social utility, although they are not actually working toward achieving 'applicable products'. This is so because part of the *fiction* implies ignoring the industrialization processes of knowledge: it operates 'as if' that work were devoted to the production of a drug, but without the elements that would allow the drug to be effectively produced.

Indeed, an important element to understand the logic of scientists engaged in research associated with Chagas is the relative 'peripheral condition'. Their local symbolic capital depends on three factors: the external recognition that they enjoy from 'mainstream' colleagues in advanced countries and/or the participation in international prestigious networks, the international publications that they can show to their institutions (closely linked to the former), and the local usefulness (real or abstract) of the knowledge they are producing.

Yet, to take part in international networks Latin American researchers have to adapt their agendas to the main research lines promoted by national, international or supranational agencies located in (and governed by) the most advanced countries. The priorities of these agencies (EU, WHO, NIH, American foundations, etc.) are set up depending on the dominant actors within each context; for instance, in the EU, national States, industrial partners, scientific advisors and NGOs, among others, negotiate to define and establish the research priorities.

Given this fact, when Latin Americans are invited to take part in international networks, projects or consortia, the agenda is already well established and they can 'take it or leave it', but not modify either the core subject or the methods (Kreimer 2010a). The aforementioned 'Trypanosoma cruzi Genome Project' may be a good example: Why might American and Swedish researchers be interested in T. cruzi? Is it because they are afraid of a sudden emergence of Chagas disease in their own countries? Of course not! Are they willing to develop new drugs to treat sick people? The answer is negative again. However, the international research networks can use the DNA of T. cruzi for other purposes, e.g. the study of biological mechanisms of the regulation of genetic expression (Agüero 2003).

Latin American researchers on T. cruzi actually built *other problems*, even when they said that they continued working on Chagas disease. In terms of the coproduction of a public and a scientific problem their intervention was decisive, positioning the production of knowledge about the parasite's DNA center stage, and displacing, at least partially, other solutions to the Chagas problem, such as systematically fumigating rural houses. In fact, less prestigious but more useful research could be conducted, such as the development of new kinds of insecticides. But such research would not allow the researchers to participate in international scientific networks.

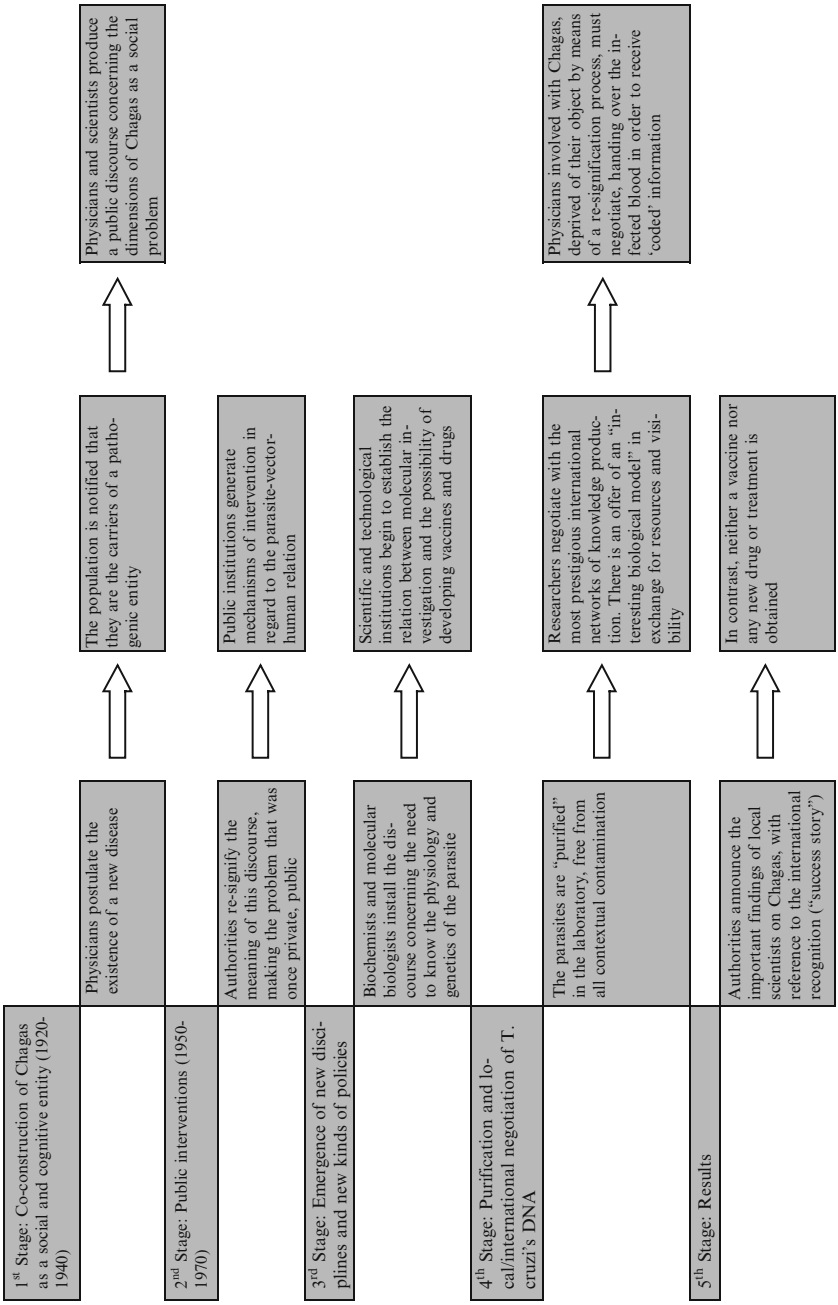

Fig. 10.1 Stages in the co-production of chagas disease as a social and scientific issue

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