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Latin American science, technology, and society: a historical and reflexive approach¹

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ABSTRACT

The paper deals with the emergence and development the STS field in Latin America, from the sixties on. After an introductory section containing some considerations on the maturation of and approaches to STS in the region, the paper delves into cognitive, institutional, political and social dimensions of the development of this field. It gives then some background, mentioning policies as drivers of knowledge generation, the institutionalization of social studies of science and technology, and STS training. An individual section deals with journals and congresses as spaces for interaction. A chronology of the STS field's development in Latin America is followed by a brief examination of the role of the STS field in contemporary Latin America. It is argued that researchers belonging to this community are in a good position to critically analyze the current relations between science and society, to assist decision-makers and help the public understand the implications of present-day technoscientific change, as well as to support the development of fairer, more equitable solutions to combat the challenges of today's changing world. It goes without saying that, far from having reached maturity, this is a space in a permanent state of construction.

KEYWORDS

Latin American STS; Science and society; Emerging of research fields

1. Some opening thoughts on the maturation of and approaches to STS in Latin America

Where does a new research field start? The question is not a trivial one. While a field's origins become naturalized with time in a certain common sense, this generally conceals the vagaries, doubts, conflicts, or tensions that have transpired before a field of knowledge and inquiry stabilizes according to different indicators that can be selected on the basis of what it is wished to emphasize.

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Since, in contrast to other fields, the very origin of a new research space is one of the science, technology, and society (STS) field's objects of study, a few remarks on the subject are inevitable.

The analysis by Graham, Lepenies, and Weingart (1983) on the uses of the history of disciplines is particularly interesting: they point out that different groups produce histories of science that target different audiences, each history possessing a different function. First, they identify the function of legitimization, which recognizes two very different perspectives, both produced by the very practitioners of a particular discipline. One of these perspectives is geared toward the "general public" and depicts the "heroism" of a given discipline's pioneers or founders. In some instances, histories aimed at a mass audience are couched in a legitimate battle to consolidate a new field or discipline seeking to carve out a space for itself among the established disciplines. Such works are akin to scientific popularization activities inasmuch as they disseminate the findings of a discipline. The other perspective also has the function of legitimization, but in a discipline geared toward researchers in the field, as well as students and newcomers, in order to retrospectively demarcate the hegemonic traditions within it.

If these two perspectives are viewed as "internal" to a given field, there would, according to the authors, be other "external" histories, originating most notably in the social studies of science (SSS), and "undermining the aura of heroic achievements and the sanctity of elitism they transmit an image of science as an everyday, social activity which is not aloof from challenges of democratic accountability. Thus, the 'social studies of science' are not real 'histories' of disciplines, but systematic analyses which focus on the conditions of the historicity of scientific development" (Graham, Lepenies, and Weingart 1983, 14).

Professional historians of science cut across both perspectives, often with initial training in their chosen field, or with a subsequent background in technical, theoretical, and epistemic issues. They distance themselves from internal history and try to link the history of the disciplines with a broader political, economic, or cultural history. This perspective seems to fall "in between" the "inside" perspectives and the "outside" view or analyses of the discipline itself.

This acute analysis encloses a paradox that the authors seem not to have noticed: both schools of thought – particularly SSS – consider histories arising from practitioners in the field simply as additional material for analysis and do not, *a priori*, attribute to it any more truth value than the expressions of practitioners in any other social field. This goes beyond the different functions performed by the disciplines' varied historiographies, quite apart from the problematic analytical distinction between the "historiography of science" and the "social studies of science." And this involves taking the reconstructions of a particular discipline as sources that help to pinpoint the position of actors at a given moment in history.

Keeping these limitations in mind, we now face an additional challenge by attempting an analysis of the STS field, we are putting ourselves "on both sides of the desk": on one hand, by trying to track the histories of practitioners as a legitimization of their lineage; on the other, of course, by appealing to a wider audience – the social sciences in general, for example (Kreimer 2017) – but as participants in this field for many years, we also have the vices of an "inside" view.

We propose to solve such limitations by turning to the notion of *reflexivity*, an idea that reaches far back into the social sciences. It was originally floated by certain colleagues from the STS field, particularly from the second half of the 1970s by such authors as Bloor, Woolgar,

or Ashmore. Instead of applying reflexivity to the way we produce sociological knowledge, we apply it to the way we have been shaping a new field.¹

As a starting point, we may note that the various issues surrounding the development of sciences and technologies from a Latin American standpoint have, for several decades, been drawing the attention of a growing number of specialists in countries across the region.

It therefore makes sense to ask ourselves what indicators would help us assess the maturity of the field and verify its effective emergence and development. We could organize these indicators into four distinct groups: (a) *the quantitative dimension*: growing numbers of specialists recognized as belonging to the field; (b) *the institutional and reproductive dimensions*: the creation of specific research and training facilities in the field; (c) *the productive dimensions*: a considerable volume of scientific production, and spaces for publication and circulation; and (d) *the cognitive dimensions*: the establishment of their own research objects, in particular, the design of suitable theoretical and methodological approaches to account for these objects.

In quantitative terms, the field, self-styled as “social studies of science and technology” (SSST) or “science, technology, and society” (STS), has clearly recruited a growing number of researchers and students. This developed apace between the 1980s and the 2000s, later leveling off at somewhere between 500 and 600 active researchers, if we take into account biennial congresses in different countries across the region.

In institutional terms, almost all the countries have postgraduate research and training centers, some devoted exclusively to the STS field, others shared with groups working on other areas in the field of social sciences. Certainly, this development is not homogenous, since both Brazil – notably – and Argentina have shown greater dynamism than other countries. Nevertheless, we have verified the existence of various groups geared toward these issues for many years in Venezuela, Mexico, Colombia, and Uruguay, and more recently in Chile, Costa Rica, and Ecuador.

The productive dimensions have also been accompanied by quantitative growth in the number of researchers. Without going into an exhaustive analysis, this may have developed rather more slowly in the early days (when there was just a handful of more productive researchers), whereas, in recent years, it seems to have accelerated, possibly driven by higher levels of institutionalization among the new generations, as well as evaluation policies of scientific activities primarily promoting publications in peer-reviewed journals.

We will come back to the cognitive dimension – which we believe to be fundamental – after we have taken a general look at the development of the field.

Broadly speaking, researchers in the field seem to have attained enough maturity to create a scientific and intellectual production whose quality, and thematic and conceptual diversity form an extremely interesting mosaic of research and thinking. There is, however, a question mark over whether developments in this field provide inputs to reflect on Latin American societies. Even if the narrower framework is defined as the study of the relationships between “sciences, technologies, and societies” (the plurals here are valid), we believe they are not unrelated to the cultural, ideological, idiosyncratic, political, or economic dimensions pervading all actors in the region.

The field may, then, also be understood as building a bridge for dialog in various senses: first, between scholars and academics from other fields in the social sciences tackling specific Latin American social questions without paying particular attention to the development of

¹For a discussion of the question of reflexivity and its application to Latin America, see Arellano Hernández (2007).

science and technology (S&T), or to its causes and consequences, histories, and future challenges. Second, it also bridges the gaps between other actors, as well as practicing scientists and engineers, who have increasingly been recognizing the value of SSST to help them understand their own practices and think about their consequences. This bridge extends further to the various authorities – “decision-makers” or “policy-makers,” as they are often termed – who have, in recent years, been approaching and interacting with those working on a (typically critical) analytical approach to scientific and technological development. Last, though no less important, there are the reflections on how S&T affects our societies and how to actively intervene in decisions that could be taken more collectively and participatively.

2. The emergence and development of SSST or STS in the region

2.1. Some background

As we have said, in the emergence of every new field of research, different definitions and tensions permeate disciplinary questions, struggles over the definition of what constitutes a “legitimate” object of research, institutional dimensions, historical experiences. Early last century, the first systematic reflections on S&T emerged out of widely differing traditions: in the field of the sociology of science, the works of Robert Merton in the United States (who in turn recognized Mannheim’s contributions in Germany), from the late 1930s, gave normative-functionalist research a dramatic boost. Elsewhere, from the 1920s, a historiographical perspective close to the philosophy of science also problematized the question of scientific development in the works of Alexandre Koyré, Gaston Bachelard, and others. A third school, which would always be present in this field, was that of practicing scientists who started thinking about various issues related to science and technological development. Possibly the best-known textbook case was John Desmond Bernal, an English crystallographer who in 1939 published his famous influential book, *The Social Function of Science* from a conspicuously Marxist standpoint.²

Toward the 1970s, there was a major turn involving the convergence of various sociological perspectives with a historical approach, breaking down the rigid distinction between the *internalism* of historical–philosophical perspectives and the *externalism* of functionalist sociology, and giving rise to a new, more complex field of research. According to various authors (in particular Callon and Latour, although the view is widely shared), the turning point might be marked by Thomas S. Kuhn’s 1962 classic, *The Structure of Scientific Revolutions*. Since then, disciplinary boundaries have been overcome, a lasting mark on the field, which, unlike other areas of knowledge production, has also become permeable to scholars trained not just in the social sciences, but in “hard” fields like physics, mathematics, and engineering.

It was then that the first tensions arose over the definition of the field’s epistemic and social status (which Derek J. de Solla Price had, in the 1960s, called the “science of science”): on one side, there was an approach that emphasized its interdisciplinary nature in the broadest sense; on the other, one that restricted it to a subfield of the social sciences. The first definition appears for the first time in Merton’s book (1938, 360, which was his 1937 doctoral

²The Society for Social Studies of Science (4S) has named its annual highest award the John Desmond Bernal Prize in recognition for distinguished contributions to this field.

thesis), as “science, technology, and society,” while the second can be traced to the “PAREX” Project (a portmanteau of Paris and Sussex), which brought together sociologists and economists from the two cities, who met annually from 1971. That year, some researchers from Sussex and their Edinburgh colleagues founded the journal *Science Studies*, which four years later became today’s *Social Studies of Science*. Here sociological, political, and historical analyses converged with a common matrix characteristic of the emergent *constructivist* perspective. Again in the 1970s, *Science, Technology, and Human Values* appeared in the United States, accompanying the development and dynamics of SSST there.

Nowadays, the notions of STS and SSST have become practical equivalents and are used interchangeably. It is worth noting, however, that the tension over the origins of science studies, and its disciplinary components, epistemological assumptions, theories, methods, and ultimate goals, has not been fully resolved, and the boundaries of the field – both in Latin America and other regions – remain porous and are being redefined on a fairly periodic basis.

In Latin America, from the late 1950s to the early 1980s, a strong political concern predominated in various sectors of the scientific and technological community. It was fired by three significant problems: one, the question of the region’s *technological dependence* on the more advanced countries in industrial terms (Dagnino, Thomas, and Davyt 1996); two, the absence of virtuous relations between the development of S&T and innovations (Sábato and Botana 1971); and three, a questioning of the very nature of the sciences and their role in a peripheral context like Latin America (Varsavsky 1969).

Authors like Jorge Sábato, Oscar Varsavsky, Amílcar Herrera, José Leite Lopes, Simon Schwartzman, Marcel Roche, Máximo Halty Carrere, Miguel Wionczek, Arturo Rosenblueth, Alejandro Nadal Egea, and Francisco Sagasti produced various arguments backing endogenous development, and highlighting the active role of governments in national research and development trajectories. The period saw a predominance of militant speeches and writings by scientists and technologists. In the 1960s and 1970s, a group of scientists engaged with the institutionalization of scientific and technological activity in their countries. Their inquiries centered around how to make S&T contribute to the development of their societies.³ As public actors, they often sought to occupy decision-making positions to effect social change. Their commitment drove a movement geared to the transformation of their societies, and they believed in S&T as an important tool to achieve it.

In fact, there was an entire international movement geared to questioning science which operated as a true “sign of the times”: starting in the late 1960s, there had been a process of “radicalization of science” in the developed countries, led by scientists on the left, as described by Rose and Rose (1976). Motivated by the Vietnam War and the protests of May 1968, European and American scientists set up several associations, like Scientists and Engineers for Social and Political Action (SESPA) or the British Society for Social Responsibility of Science (BSSRS), that questioned the role of science in the capitalist system. This three-pronged critique: (a) questioned the uses of science and exposed abuses, like environmental risks or imperialist uses of S&T during the Vietnam War; (b) argued that science is an ideologically non-neutral activity that reflects the standards and ideology of a given social order; and (c) challenged the idea of science’s autonomy by highlighting the internal barriers within the laboratory that produce individualistic and elitist scientific practices, or between the

³Certainly, in spite of many researchers’ strong political concerns, many others went on working in their laboratories, more involved in generating “high quality knowledge” legitimized by the international community of specialists.

laboratory and the outside world. These debates were relayed in various publications, like the journal *Science for the People*, the official organ for SESPA, whose watchword “science for the people” was taken up by similar movements in Europe and the United States, and has also been adopted by certain actors in Latin America (Feld and Kreimer 2012).

Despite such common concerns, which the literature on the subject has identified with a common (and insufficiently nuanced) matrix, there were then, at least, two schools. On one side, there was a radical school, the most representative author of which was Oscar Varsavsky, who at once questioned the organization of society and the hard core of science, along with its practices, agendas, means of financing, methods, and dependence on the hegemonic centers. On the other side, was a more moderate school associated with developmentalist ideas held by authors like Jorge Sábato, Alberto Aráoz, Fernando Fajnzylber, and Michael Wionczek, who questioned how to promote scientific development to act as a lever for socioeconomic development. Between the two perspectives stood Amílcar Herrera (1971), who strongly challenged capitalist society, but not the whole of “Western science dominated by a mode of production imposed by the United States and the Soviet Union,” as Varsavsky (1969) railed.

This clash of ideas highlighted a process of politicization in science that entailed a broad range of questions: for the “moderates,” this involved searching for analytical and normative tools to implement public S&T policies; the “radicals” preached the integration of S&T in politics *tout court*.

Through this politicization, they attracted the attention of industrialists, policy-makers, other scientists and technologists, and other members of public interest groups who sought modernization in different ways as an active and heterogeneous conglomerate.

Several of these authors participated in a collective book, compiled by Jorge Sábato (1975) entitled *El pensamiento Latinoamericano en la problemática ciencia-tecnología-desarrollo-dependencia* [Latin American Thought in the Science-Technology-Development-Dependency Question]. Sábato’s declared objective was “to demonstrate that Latin American thought in this field does not lag behind the thought generated in other latitudes, even those where ‘the highest international level’ is to be found.” Years later, this title – slightly altered as *Pensamiento latinoamericano en ciencia, tecnología y sociedad* [Latin American Thought in Science, Technology, and Society] – would serve as a kind of mythological foundation of the field, an issue we shall come back to later.

2.2. Policies as drivers of knowledge generation

Beyond these differences, early thinking about S&T in Latin America was, until well into the 1980s, clearly very closely bound up with a political – in the sense of both politics and policy focused – rather than a merely analytical concern in institutional terms, several Latin American countries had, from the early twentieth century, set up science academies or similar institutions to promote research and obtain a degree of influence in the power structure. International organizations, notably United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Organization of American States (OAS), and, to a lesser extent, Economic Commission for Latin America & the Caribbean (ECLAC), played an important role in this decision. The setting of national economic development programs was one of the conditions that Latin American countries had to meet in order to obtain funds from the US Government under the so-called Alliance for Progress. The notions of “science policy”

and “development plan” were introduced in UNESCO’s Ten-Year Program at the Eleventh General Conference in 1960.

In 1965, UNESCO organized the Conference on the Application of Science and Technology to the Development of Latin America (CASTALA) in Santiago de Chile, attended by such renowned scientists as Carlos Chagas Filho, Rolando García, Máximo Halty, Amílcar Herrera, Bernardo Houssay, Manuel Noriega, Enrique Oteiza, Gustavo Pizarro, Marcel Roche, and others (UNESCO 1965), most of whom played a prominent role in designing and enacting science policy in Latin America. This meeting reaffirmed the need for countries to adopt an *explicit science policy*, with the active participation of scientists and technologists. It also ruled to create the Permanent Conference of National Agencies for Science and Technology Policies, held in 1968 in Caracas, Venezuela, in 1971 in Viña del Mar, Chile, in 1974 in Mexico City, in 1978 in Quito, Ecuador, and in 1981 in La Paz, Bolivia. UNESCO and other international organizations, like the OAS, the Inter-American Development Bank (IDB), the International Development Research Center (IDRC), Organization for Economic Co-operation and Development (OECD), the World Bank, the United Nations Development Program (UNDP), the International Labor Organization (ILO), the United Nations International Development Organization (UNIDO), the Pan American Health Organization (PAHO), the Board of the Cartagena Agreement, the CAF Development Bank of Latin America, and the Latin American Economic System (SELA), all had a bearing on the region’s scientific communities in the S&T field. Their actions were not always trouble free, and steering a course through the uncharted waters of international cooperation became part of the learning and strengthening of national CTI policy entities.

One channel for knowledge production came about as a result of the task to implement national S&T policies involving the need to produce knowledge in the form of information gathering and statistics, and primarily – a key issue at the time – the training of qualified human resources to do this. In the 1970s, several countries in the region took specific action along these lines and, in terms of S&T information gathering, tried to comply with UNESCO’s request, the agency that systematized comparative data on “national scientific and technological potential.”

At the regional level, driven primarily by the OAS, several studies on the right science and technology policy instruments (STPI) for Latin America were conducted, funded by the IDRC in Canada, as well as various resource surveys on and research into the skills needed in the future. Key figures in these processes were Francisco Sagasti from Peru, Fernando Nadal from Mexico, Fernando Chaparro from Colombia, Ignacio Avalos from Venezuela, Fabio Erber from Brazil, and Alberto Aráoz from Argentina, who coordinated a variety of works along these lines (Sagasti 2015).

2.3. The institutionalization of SSST

As we have noted, there are now several texts in existence that ponder the development of STS studies in Latin America, performing the dual role of reflecting on the field itself and simultaneously viewing it as an object of study. We think it appropriate, therefore, to base this section on some of them, like Vessuri (1983, 1987a, 2007), Oteiza and Vessuri (1993), Kreimer and Thomas (2004), Vaccarezza (2004), Kreimer (2007), Arellano Hernández and Kreimer (2011), and Arellano Hernández, Arvanitis, and Vinck (2012).

After the late 1970s, two breaks become clearly visible in the historical study of science in Latin America. The first relates to the question of a so-called “diffusionist” model. This model, which, as we shall see, extends far beyond the historiographical field, grew out of the need for a historical understanding of the development of science in the extra-European world, leading inevitably to the tension between “the affirmation of the positive universal nature of scientific knowledge, on the one hand, and of the now widely recognized contextual nature of scientific activity, on the other” (Saldaña 1996, 13).

Just the way in the early twentieth century, historians, marked by a strong Eurocentrism, focused on contributions to international science coming from Latin America, the 1950s saw a *discovery* of Latin American science, which some authors explained using the social and cultural matrices that had given rise to knowledge contributions. Fernando de Azevedo, in *As Ciências no Brasil* [Sciences in Brazil] (1955), showed the way science developed in Brazil in the context of general national development by inquiring into the causes of its perceived lateness compared to “central science,” in other words European science. Eli de Gortari’s book, *La ciencia en la historia de México* [Science in Mexican History] (1963), is one of the few early general investigations into Mexican science, as is its counterpart into Argentine science by José Babini (1954). By the 1990s, a historiography of professional science had taken shape, with works by the likes of Marcos Cueto (1989, 1997), Stuart McCook (2002), and Obregón Torres (2002). More recently, many other works have fed into this school, including studies by Henrique Cukierman (2007) on Oswaldo Cruz, Alfonso Buch (2008) on Bernardo Houssay, and Mauricio Nieto Olarte (2006) on natural history.⁴

Interestingly, unlike in Europe and the United States, the functionalist oriented sociology of science in Latin America was rare in sociology departments, although it did have more of a presence among groups conducting bibliometric studies in an attempt to produce indicators (Schwartzman 1985; Velho 1994). As we have seen, the study of scientific and technological development was, until the 1980s, primarily the object of historically or politically inspired approaches. The turn implied by constructivism did not therefore establish itself in the region on critiques of normative models, but on different grounds: the predominance of “nonsocial” historical perspectives, of political rather than analytical perspectives, and of a kind of knowledge production whose function was not its academic legitimation, but its possible utilization in developing policy instruments. So what was posited then under Sismondo’s umbrella term of the “constructivist metaphor” (which proclaimed a focus on “science in the making,” not just its products, and on the specific practices of knowledge production) was extremely novel.

Indeed, the few sociological or sociohistorical studies conducted before the 1980s, were aimed at explaining the development either of scientific communities at the national level or of a few specific disciplines. As Hebe Vessuri (1987a) writes, a few pioneering works can be identified in this area, notably by Edmundo Fuenzalida (1982) in Chile, Simon Schwartzman ([1979] 1991) in Brazil, and Marcel Roche and Yajaira Freites (1992) in Venezuela. Fuenzalida conducted a study on the behavior of Chilean scientific research in a heavily stratified international context and on the real status of scientists in developing countries, whereas Schwartzman reconstructed the emergence and development of the scientific community in Brazil from its beginnings and Portuguese heritage to more “modern” times of true institutionalization of scientific research in that country. Roche (1979), for his part, undertook a “sociological empirical study of the Venezuelan scientific community.” Using surveys, he

⁴For an overview of the history and historians of science in Latin America, see Vessuri and Kreimer (forthcoming).

focused on the study of the psychosocial traits of the Venezuelan scientific community. These were pioneering studies on a novel subject about which very little was known, and were aligned within a “sociology of scientists,” rather than in the conditions and processes of knowledge production.

Starting in the 1980s, there was an institutionalization of SSST in various institutions. It came about through specific groups based in institutions practicing more general research: in Mexico at the Colegio de México, the Institute for Social Research, and the Center for Technological Innovation (the latter two belonging to the UNAM) and in Peru at the Group for the Analysis of Development (GRADE). Others established themselves in institutions devoted entirely to these areas, like the Area of Science and Technology of the Center for Development Studies (CENDES) of the Central University of Venezuela, the Department of Political Science of the University of Campinas (UNICAMP), the Departments of Technology Management and History of Science, both at the University of São Paulo (USP), the Production Engineering Program (COPPE) at the Federal University of Rio de Janeiro (UFRJ), the Department of Science Studies of Venezuelan Institute for Scientific Research (IVIC), and the Carlos Finlay Institute for the Study and Organization of Science of the Academy of Sciences of Cuba, or, later on, the Science and Technology Studies Institute (IEC) at the National University of Quilmes (UNQ), in Argentina, among several others.

Research was conducted in dimensions and disciplines of the academic environment, and formed schools to analyze and understand S&T, and its social relevance in the Latin American regional context. An original diversification of disciplines – sociology, anthropology, economics, history, philosophy, and so on – became an interdisciplinary mix of disciplines and approaches, though a certain relative disciplinary weight does still exist. Groups for sociology, social history, anthropology, and political studies of science are increasingly being organized, and for the economics of innovation and technological change, many of which converge in common spaces for interaction and debate. Many works thus incorporated concepts from different theoretical traditions into their analytical frameworks (one of the most common operations being the triangulation of elements from the sociologies of knowledge and science with conceptualizations of public policies or economics). In the last two decades of the twentieth century, the SSST field expanded both quantitatively, with more publications, more researchers, more human resources education and training, and qualitatively, with greater thematic diversity, the pluralization of the theoretical and methodological approaches deployed, the institutionalization of research, and human resources training.

Two complementary – and apparently paradoxical – movements occurred during these years on the one hand, the emergence and reception (sometimes critical, often “uncritical”) of the various constructivist approaches brought about a dissolution of disciplines, where knowledge as an object permeated studies focused on science, as well as those centered on technology. This assumes particular relevance in works with approaches related to the study of “knowledge networks” (Casas 2001) and to the Sábado Triangle-Triple Helix view.

The production of works in sociology and history of science and technology developed in the 1980s and 1990s in parallel to the dissemination of new constructivist sociology concepts in the region. The adoption of this perspective led to a fairly extensive series of empirically based research projects and programs. In response to the previous phase’s general and at times essayistic production, there has, over the past two decades, been a leaning toward theoretical and methodological approaches based on a professionalization of

archiving and documentation, and those based on field work (case studies, various interview techniques, actor network reconstruction, socioinstitutional analysis, ethnomethodological studies).

At the same time, the way of profiling objects of analysis changed. While the major themes of S&T policy did not disappear at national level, a focus eventually emerged on discrete objects like groups and lines of research, R&D institutions, artifacts and production processes, and the processes of knowledge production. In other words, where priority had previously been given to the macro space, there was now a leaning toward micro- and mesoanalytic levels. Vessuri (1984, 1987b) produced some of the first detailed social studies of disciplines and research groups in the 1980s.

In parallel to this “micro” orientation of works and to the constructivist approach, there gradually developed a common concern for the study of certain specific academic fields (communication, education, physics, chemistry, biology, and so on), undertaken more often than not by researchers initially trained in the field under study, along the lines we described at the start of this article. The study of disciplinary fields was, however, increasingly addressed by “professional” sociologists, historians, and anthropologists of science. At the same time, concern for the study of scientific fields went hand in hand with the powerful influence of Pierre Bourdieu over the Latin American social sciences beginning in the early 1980s. As a consequence, many Latin American studies on the dynamics of scientific fields have been conducted using Bourdieusian categories, such as “symbolic capital,” “habitus,” “fighting forces,” and so on.

Certain particular lines of work took up the challenge of the principle of symmetry proposed – in radical or moderate formulae – by relativist theories like Callon and Latour (1992) for the radicals, or Collins (1981) for the moderates. However, in a significant number of cases, self-styled relativist and constructivist studies have not, in practice, ventured beyond the scope of externalist studies focused on socioinstitutional aspects. Although they did incorporate the product of (scientific and technological) knowledge, they treated it as a secondary question, without exploring the construction of explanations in any great depth.

The adoption of the new constructivist conceptualizations gave rise to a series of thematic resignifications and displacements. On the one hand, it led to a revision of themes previously approached from other perspectives. Old questions were revisited: How do scientific disciplines form at the local level, for example? How do scientific and technological community interact intra- and extra-regionally (Kreimer 2011)? What is the relationship between scientists and the market (Vessuri 1995)? What is the relationship between processes of knowledge production and the production of goods and services (Vaccarezza and Zabala 2002)? What is the relationship between S&T policies and the strategies of various actors?

On the other hand, some critical works stated that the new constructivist concepts could not fully explain local dynamics. These works focused particularly on the limitations of the conceptualizations of “actor-network” and “technoeconomic networks” as appropriate analytic tools to account for phenomena related to such inescapable Latin American situations as peripheral location, transnationalization, and globalization of production, the structural political weakness of state offices, or the plight of R&D units.

Over the years, a visible tension emerged on one hand was the relationship between concerns over an intervention in S&T policies and the need to generate knowledge; on the other, the growing requirements of globalized models with a heavy emphasis on increased publication and its consequent increase in international visibility in response to social uses

Table 1. The STS field's development in Latin America by generation.

Generation	Disciplinary affiliation	Institutionality	International links	Main features
<i>1st Generation:</i> "Pioneers"	Primarily scientists and engineers (some economists)	Low: Individual efforts or works produced in institutions not devoted to STS studies	Mainly with Latin America, facilitated by support from international agencies (UNESCO/OAS/IDRC/World Bank)	Political dimensions and originality in the formulation of a "Latin American Thought." Significant levels of creativity
<i>2nd Generation:</i> Primarily trained on foreign postgraduate programs	Generally in the social sciences: those with a background in the natural sciences or engineering followed postgraduate studies in social sciences (in the fields of STS and the economics of technological change)	Medium: Individuals setting up institutional groups and spaces specifically for STS research and training purposes	Strong: A generation almost entirely trained in academic institutions in the developed countries, with whose leaders they keep up strong collaborative ties	The "political" emphasis gradually shifts (without totally disappearing) to thematic, theoretical, and methodological concerns related to the establishment of the STS field and the training of disciples
<i>3rd Generation:</i> Trained on local postgraduate programs	Normally in the social sciences on both STS undergraduate and mainly postgraduate programs	High: Researchers with a wide-ranging disciplinary base centering, in some institutions, on the social sciences and economics	Medium: Disciples from the previous generation, many of whom developed the same ties, but less intensely	More academic rigor in theoretical developments than previous generations, albeit demonstrating less originality and fewer "political" concerns
<i>4th Generation:</i> Trained in consolidated teams	Of varied disciplinary origin, with the social sciences predominant	High: And "normalized" through local research and science policy institutions. They often work in centers and institutes devoted solely or mainly to STS studies	Medium: But on the increase. On a personal level, the main leaders are local Latin American STS leaders, but at the conceptual/analytical level, the leaders are European and American authors, in ties reinforced by postdoctoral courses	Significant (and "normalized") academic rigor. International agenda incorporated with less criticism. Rediscovery of "political" dimensions

of knowledge. Nonetheless, from the late 1980s – most notably in the 1990s – there was a certain rapprochement between S&T policies and concepts and ideas from the STS field. Still, this did not come about through the adoption of a critical line toward science's role in society, but on the contrary, through most of the region's governments' adoption of concepts from innovation economics, and through the need to raise productivity and competitiveness in the national economies. Notions like "National Innovation System" thus burst upon the discourse – usually in an uncritical, instrumentalized way – and upon many of the practices of S&T policies in those years.⁵

2.4. STS training

In parallel to the institutionalization of the field, various training programs for new researchers appeared, which could be framed in a strategy of "extended reproduction" for the STS field. As we demonstrate in Table 1, despite significant asymmetries across generations and age groups, a significant number of those shaping these graduate programs had been trained outside the region, which had no spaces for any such activity. However, the outlook changed when spaces for postgraduate training, in the form of master's and doctoral degrees, were set up in various countries around the region. Throughout this time, there was notable diversity in the academic backgrounds of specialists incorporated into the field, where sociologists, anthropologists, and historians rubbed shoulders with engineers, biologists, physicists, and various other professions.

For more than three decades, numerous programs were set up, the first of which was the CENDES in Caracas (the master's degree in "Science, and Technology Development Policy and Planning"), a few years after the first programs of the kind were established in Europe (mainly the United Kingdom and France). There followed a similar program in Brazil, in the Department of Science and Technology Policy (DPCT) of the UNICAMP, together with History of Science and Innovation Management Programs at the USP, Production Engineering with a specialization in the field of Science and Technology Policy at the COPPE-UFRJ, the University of Buenos Aires (UBA), the Autonomous University of Yucatán (UAUY), the Metropolitan Autonomous University (UAM) in Xochimilco, and several others. In the latter half of the 1980s, the Montevideo-based UNESCO Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC) promoted the publication of a catalog of postgraduate courses in "Planning, Management, and Social Studies of Science and Technology" (UNESCO/ROSTLAC 1990) and provided the institutional and financial support to establish a Postgraduate Programs Network (red POST), operational from the late 1980s to the start of the new millennium. By the end of the 1990s, eleven graduate programs had been surveyed (in general master's and some doctoral degrees), although their number went on growing in the following years.

All this movement meant that, by the 2010s, a significant number of young people had been trained in Latin American postgraduate programs, strengthening both research in SSST and, in some cases (certainly far fewer than expected), providing trained professionals to serve as officials in state offices in the field of S&T policies.

⁵For an analysis of the conceptions of science policies and their knowledge base, see Velho (2011).

2.5. Journals and congresses: spaces for interaction

From the mid-1990s, the Latin American Conferences of Social Studies of Science and Technology (ESOCITE Sessions)⁶ were held biennially, alongside permanent seminars, and national and Latin American forums, with growing numbers of researchers and groups with backgrounds in postgraduate research and training. Since 2002, Latin American doctoral schools in STS have also been held biennially (alternating with the ESOCITE conferences), and attendances are still growing.⁷

In parallel, the Latin-Ibero-American Association for Technology Management (ALTEC) has held periodic conferences informed mainly by issues relating to innovation economics, administration, and technology policies. The Latin American Society for the History of Science and Technology has also organized periodic meetings.

There have, for several decades, been journals specializing in various aspects of the STS field, including the history of science and health in Latin America. We can mention: *QUIPU*, a journal published in Mexico by the UNAM; *Historia, Ciência, Saúde*, published in Manguinhos by the Oswaldo Cruz Foundation; *REDES*, the *Journal of Social Studies of Science*, published in Buenos Aires by the UNQ since 1995, the *Revista Brasileira de História da Ciência*, and more recently, *Eä – Journal of Medical Humanities & Social Studies of Science and Technology* supported by the Argentinean Society for the History of Medicine (SAHIME). The *Revista Iberoamericana de CTS* has been appearing for over a decade now, published jointly by the Organization of Ibero-American States (OEI), the *REDES* group, and the University of Salamanca.

The UNQ has been publishing its “Science, Technology, and Society” book collection for over a decade, which now runs to more than a dozen volumes, alternating authors from the region with translations of STS classics. And in Brazil, the Minas Gerais publishing house Fabrefactum has also published numerous works on the sociology of science, primarily by English authors.

3. A chronology of the STS field’s development in Latin America

Table 1 organizes the field’s development by generation. Naturally, there are certain asymmetries in these generations’ components, but in general, the process of *institutionalization* has, in recent decades, also accompanied the process of *professionalization*, both elements key to scientific development.

There is general consensus that the first generation corresponds, broadly speaking, to representatives of so-called “Latin American Thought in Science, Technology, and Development,” which boasted the figures we mentioned above. While some were prominent in the institutionalization process, they were more concerned about explaining the role of S&T in the development of Latin American societies and about imagining various ways to intervene. Some carried out more systematic studies, while others played a more political role. But they all helped to bring to public attention questions to do with the relationships between science, technology, and society, especially their political dimensions.

⁶The first was held in Buenos Aires in 1995; then came Caracas 1996, Querétaro 1998, Campinas 2000, Toluca 2004, Bogotá 2006, Rio de Janeiro 2008, Buenos Aires 2010, Mexico City 2012, Buenos Aires 2014 (a joint meeting with 4S), and Curitiba 2016.

⁷The first three were meetings of young researchers: Buenos Aires 2002, Blumenau 2004, and Curitiba 2007. After the fourth meeting, Caracas 2009, it was formally elevated to the status of a Doctoral School and held meetings in San José de Costa Rica in 2011, Florianópolis in 2013, Valparaíso in 2015, and Bogotá in 2017.

Following the principle of reflexivity we mentioned in the opening of our article, we should note that to view the representatives of “Latin American thought” as a first generation is not a neutral operation: strictly speaking, only Amílcar Herrera at the UNICAMP and, in part, Enrique Oteiza in several institutions (CLACSO, UNESCO, and so on) have played a relevant institutional role. Nor is it possible – these and a handful of other cases aside – to track a direct influence on the formation of disciples who have been actively incorporated in the STS field. At the same time, many illuminating texts like Varsavsky’s read more like essays with a heavy dose of intuition than the rigorous research that would later be required.

If today there is then a certain consensus over the representatives of that generation as pioneers establishing STS in Latin America, it is more likely due to the claim of constructing a lineage that emphasizes political concerns and the vindication of thinking *made in Latin America*, rather than a faithful portrayal of the field’s academic institutionalization.

This is no doubt bound up with the ambiguous nature of the STS field, a phenomenon true not just of Latin America. Susan Cozzens, for example, has suggested that, rather than a field, STS should be considered a *movement*. Other authors, like Steve Fuller, have also asked questions about this issue and identified a more theoretical, academic, “High Church” school, and another “Low Church” perspective, oriented more to interacting with wider audiences beyond academia. Sismondo (2007) took up this problematization and posited it in terms of two variables: fundamentality, on the one hand, and political values, on the other, the maximum of both variables being marked by an “engaged program”.⁸

By the second generation, greater concern for institutionalization is seen across Latin America, with the creation of specific training programs for new researchers (we earlier referred to this as “extended reproduction” of the field) and specific research programs within various universities and research centers. Later, in the early 1990s, publications were produced more actively while social spaces of interaction multiplied, most notably through the ESOCITE conferences, which brought into existence the *Latin American Association of Social Studies of Science and Technology* in 2006.

Throughout this process, research became increasingly “formalized,” bolstered by a significant expansion of master’s and doctoral programs within the social sciences. These were generally accompanied by institutions for postgraduate promotion, evaluation, and regulation (such as the Coordination for the Improvement of Higher Education Personnel (CAPES) in Brazil or the National Commission for University Evaluation and Accreditation Argentina (CONEAU) in Argentina), as well as various funding agencies, which, through scholarship schemes, established formal standards and specific deadlines for postgraduate theses.

Thanks to this process, the new researchers entering the field (the third and fourth generations) did work with significant rigor. However, their research agendas were somewhat restricted, being geared largely to works already undertaken by previous generations. Therefore, they had less room to make thematic innovations than their predecessors. It is normal in the development of every field, as it stabilizes, for the firstcomers to have *a whole unexplored thematic horizon*, as long as specialization later takes place and research traditions are developed, including themes, concepts, and methodologies of their own. Increased academic rigor, systematization, standardization, and specialization of “forms of research” are thus accompanied by less thematic diversity and by the application of already well developed methodologies.

⁸For a discussion of these tensions in Latin America, see Kreimer (2015).

This all took shape amid a tension between the (often uncritical) adoption of concepts developed by the representatives of the STS field in the more advanced countries and the development of homegrown theoretizations. Political concerns were never totally absent from STS research agendas in the region, and indeed (generally critical) studies on Science, Technology, and Innovation (STI) policies have comprised much of the research, unlike in the United States, where S&T policy studies have had far less leeway to intersect with SSST. Nevertheless, young people entering the field – the fourth generation – have shown renewed interest in the political dimensions of S&T.

4. The role of the STS field in contemporary Latin America

If we contrast the STS research agendas of the United States and Europe – the two most traditional regions – with Latin America, we observe many shared interests, as well as particularities in individual agendas. Keeping in mind that we are advancing general observations and therefore some simplification is unavoidable, the US research agenda contains a preponderance of gender and sexuality issues, feminist approaches to the STS field, information, computing, and media technologies, the commodification of higher education, biomedicine/biotechnology, social and environmental justice, climate change, alternative energy sources and environmental problems, and colonial and postcolonial studies. In Europe, on the other hand, there is a predominance of studies on refugees, the role of experts and expertise, techno-scientific networks, digital humanities, new sciences and technologies, and the concern to attain sustainable societies. In Latin America, interest is centered on the problems of science and social inclusion, knowledge production and use, center-periphery relations, science, technology, and governance policies, and gender. Recently interest in the issues surrounding the evaluation of science has also grown, particularly in the social sciences (see Dagnino 2007; Kreimer 2015, and others).

There are gaping regional differences in the volume and visibility of STS research, as expressed in the number of publications recorded in Web of Science (WoS). However, on checking regional databases like Redalyc, Scientific Electronic Library Online (SciELO), or Latindex, we see a community growing systematically thanks to the efforts of researchers and new practitioners of multidisciplinary research. Even though considerable differences exist between Latin American countries, there are certainly prolific research centers in Argentina, Brazil, and Mexico, and, to a lesser extent, in countries like Colombia, Chile, Venezuela, Uruguay, Peru, Costa Rica, and Cuba, which have nevertheless developed apace in recent years.

The range of STS issues studied in Latin America is considerable. Among emerging topics, which sometimes lag behind those explored some time ago in the US and European agendas, are technologies for social inclusion, new issues including environmental issues like climate change, natural resources, and so on; public science and STS education communication (Von Linsingen 2015); and relationships between social problems, and problems of knowledge and analysis in new fields like neuroscience, nanotechnology, biotechnology, ICTs, and so forth (see Invernizzi, Foladori, and Maclurcan 2008). Latin America has pioneered the study of “center-periphery” relations in scientific research (De Greiff, 2012; Kreimer 2007; Vessuri 1983), the globalization of the social sciences, or the ownership of knowledge, particularly indigenous knowledge, and it was now that some of the statements made by authors in the region and elsewhere in the South began to be reviewed in the world centers (Olivé 1988).

Other issues present, though not as well developed, were the relations between science and democracy, the role of expert knowledge in various areas of decision-making, the inclusion of international dimensions in production processes, use of knowledge (with an emphasis on the local and the national), crossovers between STS and other fields (political science, art, and so on), methodological discussions and innovations in STS, the integration of quantitative methods like scientometrics in analysis, comparison with other regions, socio-techno-scientific disputes, risk, disaster and other event analyses (associated with S&T), studies of change in disciplinary and knowledge structures, and in knowledge production regimes, transdisciplinarity, and the different versions of citizen science and open science.

One of the distinguishing features of Latin American STS studies was the desire to transcend disciplinary boundaries. However, unlike the European or US contexts, where the field advanced primarily in the direction of sensitization to other fields of knowledge and a variety of social actors, interaction with these other spaces in our own region is more intermittent. Three lines of work, nevertheless, stand out, which, even in their early stages, tried to mobilize other actors. The first involved various initiatives to develop a citizen science that went beyond a “public understanding of science” toward greater participation by other actors in the processes of knowledge production. This included a varied mix of movements, from proponents of open access to scientific publications, to analysis and support for the production of “common goods,” through processes of coproduction of knowledge. The second was focused on developing social inclusion technologies in order to somehow retrieve the old 1970s ideas about “appropriate technologies” through analysis and participation in various specific experiences. The third involved interactions in various state bodies to try to displace knowledge economy perspectives as the hegemonic theoretical foundation in public S&T policy design. This involved influencing different instruments – like evaluation processes focused exclusively on international publications – or the orientation of technological development and innovation agendas aligned with the hegemonic countries. A powerful concern with the political dimensions of S&T persists, since these still display some continuity with the original motivations of four or five decades ago, though they are, of course, deployed in very different ways.

Interdisciplinary research between the social and natural sciences has been intermittent and has only started to grow in recent years. There is still a long way to go in this direction, under circumstances where funding and development agencies are not always understanding. There is an additional problem, certainly not exclusive to Latin America (Kreimer 2017): namely that social scientists tend to ignore SSS. To put it another way, most sociologists know very little about the sociology of S&T, or anthropologists about the anthropology of S&T. And the same applies to historians, political scientists, and communications experts. One partial exception may be economics: economists working on technology and innovation questions, perhaps due to their proximity to industrial issues, have enjoyed a relatively higher profile. In contrast, perhaps rather ironically, there are growing numbers of researchers in the exact and natural sciences who are interested in the development of the STS field.

STS researchers therefore frequently come up against obstacles in evaluation systems, since their colleagues from the social sciences who specialize in other areas tend not to be familiar with research topics in this field, or with the regional and international journals that are its most common outlet. It is nevertheless instructive to note that the development of science promotion and evaluation systems is precisely one of the topics most frequently analyzed in the STS field.

Given the challenges facing the region and the world, there is a lot more to understand about S&T's impacts on society, and about society's ability to influence the orientation of S&T in many complex ways. The sciences themselves are changing and already have little to do with the practices of nearly a century ago, when Merton made his initial inquiries. STS studies can help unravel the processes, whereby societies change and so help them to meet the challenges of forms sensitive to variable national and global contexts.

In both the social sciences and the imaginaries of actors like the mass media and decision-makers, a degree of common sense prevails wherein scientific and technological knowledge are true, neutral, objective, rational, and progressive, in line with beliefs denounced by various authors for almost four decades. This is precisely one of the problems the STS field tries to highlight. What is more, the social sciences as a whole have been challenged on the basis that, if their analyses ignore the development of S&T and of their accompanying tensions, any explanations deployed will, at best, be incomplete (Kreimer 2017).

Regarding the field and its practitioners' recognized integration in local academic communities, we have seen that the region's postgraduate STS studies are still on the rise, with new groups in countries like Chile and Costa Rica that had, until recently, displayed little development in the area. To give an idea of the diverse ways postgraduates from these programs are integrated in the labor market, let us take an example from Brazil: the DPCT's postgraduate program at UNICAMP mentioned above. Of the 195 Masters graduating between 1998 and 2012, 35 percent were university lecturers and researchers, 17 percent were exclusively researchers, and 18 percent were in management (8 percent of whom were specifically in S&T management, in both the public and private sectors). The data were similar for the 88 doctors produced by the DPCT program, 14 percent of whom worked in S&T management (Kreimer et al. 2014). To summarize, postgraduates from STS programs are training people, doing research, and working in management and consulting, thus making a defining contribution to the recognition of the field's thematic importance. Argentina is an interesting case in point its Ministry of Science, Technology, and Innovation has recently made available a number of annual scholarships for students on the country's four STS related master's degrees to orient their works to the strengthening of STI policies.

STS research stimulates – or should stimulate – public involvement in decision-making and contributes – or should contribute – to constructing scenarios for alternative futures under incomplete information conditions, to improving our understanding of the social impacts of the exploitation of natural resources and of knowledge in general, to evaluating the effectiveness of cooperation among different interest groups, and to generating and applying various types of knowledge for the benefit of its societies. In this way, researchers in the STS field are in a good position to assist decision-makers and help the public understand the implications of present-day technoscientific change, and to support the development of fairer, more equitable solutions to combat the challenges of today's changing world. It goes without saying that, far from having reached maturity, this is a space in a permanent state of construction.

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