Latin American Catalysis: As Seen through the Ibero-American Catalysis Symposia

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*Latin American Catalysis: As Seen through the Ibero-American Catalysis Symposia**

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One of the ways scientists from the world peripheries can attempt to overcome isolation and lack of visibility is by networking and associating themselves at different aggregate levels, both nationally and internationally. Scientific meetings are specially apt grounds where scientists have a chance to make contacts and become more visible. Taking as its point of departure the fact that meetings constitute a pervasive yet neglected aspect of science, this paper concentrates on the analysis of participation in a type of scientific meeting of a regional scope that has taken place periodically since 1968 and is still an ongoing operation. It is argued that meetings of this sort deserve the attention of students for a variety of reasons, especially because through time one may observe the evolution of the cognitive field and its institutional and group correlations that the series of meetings helped to create in the particular space configured by the periodical meeting.

Introduction

SEVERAL YEARS AGO (in 1994) Söderqvist and Silverstein published a paper in *Social Studies of Science* showing the usefulness of studying researchers' participation in scientific meetings as a principal source of information for the study of social aspects of science.[1] Given the

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increasing interest and formalisation of these events, the authors were surprised that by contrast with disciplines, research schools, museums and laboratories, all of which were scrutinised in detail in the literature, scientific meetings were to a large extent absent from the agenda of social studies of science and technology. In turn, scientometrics specialists have handled extensively quantitative analyses of authors of scientific papers, including different varieties of citation analysis. But they have expressed a considerable reluctance to take into account participation in scientific meetings as a valuable source in historical or sociological analyses, besides ignoring them at the time of evaluating research productivity. However, it may be observed that parallel to the increasing specialisation of science, the aims and scope of scientific meetings have also changed, becoming increasingly specialised. Today meetings not only afford settings where researchers exchange information about new theories, data and techniques; by analogy with scientific disciplines, they can also be seen as rhetorical-political units, arenas for negotiating what constitute promising scientific subjects, for the delimitation of cognitive territories and the distribution of scientific roles and status within a discipline's hierarchy.

In this paper an analysis is made of a type of meeting that takes place periodically within a prolonged period. It is argued that meetings of this sort deserve the attention of students for a variety of reasons, especially because through time one may observe the evolution of the cognitive field that the series of meetings helped create in the particular space configured by the periodical meeting. It is argued, moreover, that its significance is particularly great in connection with applied knowledge fields, for in them also representatives of firms and bridge entities with industry are to be found among participants. In this sense we have identified a specific topic for discussion, that is, the growth of national research communities in a particular cognitive field, that of catalysis, including the possible identification of national leaderships, and the development of national and international collaboration. Among the questions we raise are: Can we use participation in disciplinary meetings to trace the evolution of a cognitive field and to identify national leaders of a discipline and its subunits? Do these meetings say anything about the dynamics and morphology adopted by domestic and international collaboration? What can we learn about different national groups from the study of their participation in serial scientific meetings? Can one learn something useful about regional and cosmopolitan profiles of participation through the data afforded by these meetings? Is it feasible to map disciplinary

dynamics—for example, to determine how and when peripheral research fields, with their own research agendas, become integrated into the discipline's mainstream?

Through the study of the participation of Ibero-American researchers in a scientific meeting, the Simposio Iberoamericano de Catálisis (Ibero-American Catalysis Symposium), it will be shown how such a meeting became in time a privileged space for building a cognitive and institutional field, and a regional collaboration with unexpected implications. Although other singular meetings have overlapped with this catalysis cluster, in the sequence of sixteen meetings that have taken place uninterruptedly every two years since 1968 one may observe the frequency of participation of individuals and groups involved in the discipline within the region, and the relative position and status of participant researchers in the international domain.

Catalysis in the Region

Catalysis has been one of the most dynamic fields in chemistry since the 1960s and it has become a major component of modern industrial chemical research. In this period has occurred a radical cognitive transition in the field of catalysis and also its rapid institutionalisation and expansion, with the creation of national societies, journals (there are some thirteen international journals that carry the name of catalysis in the title, besides a considerable number of journals on related topics or the generic ones of chemistry, where catalysis research is also published), and the establishment of a large quantity of catalysis departments, laboratories and chairs.[2] International events on catalysis have also multiplied and continued to diversify. Among the most important ones is the International Catalysis Congress, of which the thirteenth will take place in France in 2003. Regional events, as for example the European Congress of Catalysis, and topical ones associated with the broad scope of catalysis, have grown as well.

Latin American catalysis has emerged in the last thirty years, as manifest in the human resources trained and the build-up of technological infrastructure. Since its beginning research on catalysis was closely linked to oil and petroleum applications. In general oil industries in the region have been state companies, with the exception of the recent privatisation of the Yacimientos Petrolíferos Fiscales (IPF) from Argentina (now REPSOL-YPF) and Petróleos Mexicanos (PEMEX) from Mexico.

Catalysis received public support in those countries rich in oil (Argentina, Mexico and Venezuela), and more recently in Brazil, Colombia, Chile and Cuba. Thus, a growth has occurred of groups in universities and public research institutes beyond the oil industry as such, with interests in the development of heterogeneous catalysis. But not only did the oil industry provide a strong stimulus to that development, it was renewed in recent years owing to the impulse of environmental regulations in the international market. There was also a growth of smaller but good-quality communities of practitioners in homogeneous catalysis and other branches like electrocatalysis and theoretical catalysis.

In Argentina catalysis research goes back to 1961 with the pioneer work of J.M. Parera in the Universidad Nacional del Litoral. One may estimate currently the presence of a research community of some 170 persons, of whom at least 100 are researchers with leadership (figures from the National Catalysis Committee). Mexico has around 140 active persons in fourteen institutions, of which about sixty are research leaders. Venezuela started to work on catalysis in 1964 when H. Noller and P. Andreu established a group at the Universidad Central de Venezuela. The Sociedad Venezolana de Catálisis lists more than 200 members, of whom at least fifty are considered to be research leaders (Ramirez 1999; Vessuri 1998). In Brazil, although there were antecedents in the 1970s when the Brazilian National Research Council (CNPq) and the Financing Agency for Studies and Projects (FINEP) tried to establish an integrated programme in the field of catalysis that culminated with the sixth Simposio Iberoamericano de Catálisis in August 1978, it was only in the 1980s that there was a boom of catalysis research (Seidel 1986). Researchers in catalysis are estimated in some 200 industries, besides those who are active in six associated industries. Brazil is the only Ibero-American country that has an industry for the production of catalysts (Antunes et al. 2000). Colombia presents a much more recent development, with some twenty-five active researchers. Chile too has approximately twenty-five researchers. Cuba and Uruguay have a smaller number. It may be said then that the population of Latin American catalytic researchers is around 850 (*lato sensu*) or 500 (*stricto sensu*).

If we consider the European countries with which Latin American catalytic researchers have more interaction, France and Spain, we find that in France the catalysis research community is estimated in some 800 to 900 people (M. Breyse, personal communication, 1999), and in Spain, some 350 (J.L. García Fierro, personal communication, 1999). Obviously, for these two European countries Latin American catalysis

presents features of particular significance, which are reflected in the collaboration and interaction in events like the one we consider in this paper (Arvanitis and Vessuri 2001).

The Ibero-American Catalysis Symposia (SICA)

The SICA started in 1968. The first one took place in Spain, with the participation of fifty-one people, and the presentation and discussion of twenty-seven papers.[3] Since then these events have grown to reach a total of 2,213 papers and 5,879 participants, with the last one being sixteenth in 1998 in Colombia. There has been an average of about 830 participants in the last four symposia. Spain and Argentina have hosted it thrice, Venezuela, Mexico, Portugal and Brazil twice, and Chile and Colombia once (see Table 1). Although not all leading catalysis researchers participate in the SICA, it is clear that practically all researchers that do heterogeneous catalysis have attended them and many of those specialising in homogeneous catalysis or other related fields have participated at least once.

TABLE 1
Frequency of the SICA, Venues, Total Number of Participants and Papers Presented

Symposium	*Years*	*Venue*	*Participants (1)*	*Papers (2)*	*(1)/(2)*
1st	1968	Spain	51	27	0.5
2nd	1970	Argentina	45	24	0.5
3rd	1972	Venezuela	62	31	0.5
4th	1974	Mexico	165	84	0.5
5th	1976	Portugal	264	118	0.7
6th	1978	Brazil	206	91	0.4
7th	1980	Argentina	146	51	0.4
8th	1982	Spain	199	63	0.3
9th	1984	Portugal	404	126	1.2
10th	1986	Venezuela	269	97	0.4
11th	1988	Mexico	357	115	0.3
12th	1990	Brazil	393	136	0.4
13th	1992	Spain	812	310	0.4
14th	1994	Chile	802	305	0.4
15th	1996	Argentina	945	371	0.4
16th	1998	Colombia	758	264	0.3
Total		16	5,879	2,213	0.4

Source: SICA.

It is to be expected that when the symposium takes place in a given country there will be a significant number of participants from that country and the neighbouring region, many of whom will not participate again in another symposium of the series. Thus, it is necessary to discount the bias introduced by geography, for there is a percentage of floating population that depends on the changing geography of the symposia and who do not have an international profile. However, it is obvious that beyond this ephemeral universe there is a collective that has been growing and reproducing through time, having mutual knowledge and interacting among themselves. In this collective there are three generations of researchers, with second- and third-generation pupils of the pioneers, who in some cases still participate actively in research and discipline building.

For the sixteen symposia held so far, a database was built that includes the names and institutional affiliations of all participants. Although there were some problems in identifying individuals as different from participants, it was possible to identify 3,492 individual researchers out of 5,879 participants (the difference being that the same researcher may have participated in more than one symposium). As often in scientific meetings, these represent a mixture in which there are invited conference givers from among leaders in the field, workshop session presenters who are self-selected (although their abstracts are usually screened by a programme committee), and shorter communications or posters. In connection with the present analysis only the so-called *ponencias* (papers) have been considered, and the *comunicaciones* (communications), *conferencias plenarias* (plenary conferences) and *revisiones temáticas* (thematic reviews)—as was the manner in which different presentations were classified in some symposia, but by no means in all—were left aside.[4] Given the lack of uniformity of the proceedings of the symposia, it was preferred to use the material, itself much more abundant and homogeneous, that corresponded to the *ponencias*.[5]

Since the main idea behind the current discussion is that a quantitative analysis of participation in meetings might provide useful information about the structure and dynamics of this regional research community in the crucial stage of discipline building, all individual participants in the series of meetings had to be considered. After an initial stage, the ratio of papers to the number of participants in each symposium remained stagnant around 0.35, which suggests that there are many participants in the symposia who attend not necessarily to present papers, but rather to be part of a specialised knowledge marketplace to establish links through reciprocal exchange of information and personal contacts. In this context,

the definition of 'contact' used by Liberman and Wolf (1997: 278) seems appropriate: 'Contact is a useful piece of information, a personal communication bounded [*sic*] in time, retained in the researcher's memory or briefcase, which generates some later action, ranging from immediately influencing his research work to expanding his general scientific culture.'

Participation and Leadership

As could be expected, most participants (72 per cent, 2,503 people) attended only one meeting in the twenty-nine years of the symposia, 2 per cent (seventy-five persons) attended at least five meetings and 0.3 per cent (seven persons) ten meetings. Only one, J.M. Parera of Argentina, attended all sixteen symposia, followed by four people (J. Blanco, J.M. Marinas and A.A. López from Spain; and B. Delmon from Belgium) who were present in thirteen meetings. It might be interesting to try to determine whether the researchers who attended these meetings more regularly were the regional scientific elite of the discipline. One could hypothesise that the greater the frequency of participation, the larger the researcher's scientific production and renown. If such was the case, the identification of the most frequent attendants could be used as a method for mapping the disciplinary leaders in the region.

It is possible that through this approach we have, as is also recognised by Söderqvist and Silverstein (1994), over-represented 'leaders' of the field since they are more likely than 'followers' to attend international meetings. But in fact what we want to identify are forms and relative positions or profiles of disciplinary leadership. The large majority of those who attended more than five SICA are recognised in their field, either because they have made valuable contributions to research, or because they have led research programmes of catalysis, or in their capacity as scientific entrepreneurs, gatekeepers or organisers of important meetings, or as promoters of training programmes, that is, as local discipline builders. To know more about the features of participants we elaborated a list of those with a greater presence in the symposia through time (Table 2).

Not necessarily did a researcher who attended many symposia have a large number of papers. Those who accumulated the largest number of papers in the SICA through time are listed in Table 3.

Next, to relate the high presence of authors in different SICA (Table 3) with an independent measure, Table 3 was contrasted with a list containing the same authors' general productivity through time, understood as

TABLE 2
Attendance Frequency of the SICA

Name of participant	*Country*	*Presence in number of symposia*	*Percentage of participation*
Parera, J.M.	Argentina	16	100
Blanco, J.	Spain	13	81
Delmon, B.	Belgium	13	81
López, A.A.	Spain	13	81
Marinas, J.M.	Spain	13	81
Grange, P.	Belgium	12	75
Frety, R.	France	12	75
Guisnet, M.	France	12	75
Schmal, M.	Brazil	12	75
Castro, A.A.	Argentina	11	69
Kremenic, G.	Spain	11	69
Mendioroz, S.	Spain	11	69
Pajarez, J.A.	Spain	11	69
Bolívar, C.	Venezuela	10	63
Campelo, J.M.	Spain	10	63
Corma, A.	Spain	10	63
Goldwasser, M.	Venezuela	10	63
Gómez, R.	México	10	63
Rosa B.M.	Venezuela	10	63
Scelza, O.A.	Argentina	10	63
Soria, J.	Spain	10	63

Source: SICA.

the number of publications they had registered in the *Science Citation Index* (SCI) (ISI 1985–99) during the same period in which they were active in the SICA and the number of citations their publications received (Table 4). According to the SCI, there are six European leading participants who are clearly more published than the most published Latin American ones. Typically, they also have more connections with Latin Americans through coordinating research or exchange programmes. Thus, with more than 200 publications there appears only one Latin American (Ricardo Gómez from Mexico) versus three Europeans (Avelino Corma, José Luis Fierro and B. Delmon), closely followed by three other Europeans. But there are three Latin Americans versus two Europeans with more than fifty publications. It is also clear that English prevails as the favoured scientific language, and that the number of co-authors per publication oscillates between three and five.

In connection with the most productive researchers (according to the SCI), the most cited papers were identified (Table 5). Among the

TABLE 3
Researchers with the Highest Number of Papers Delivered in the SICA

Name of participant	*Nationality*	*Number of papers in SICA*
Schmal, M.	Brazil	52
Delmon, B.	Belgium	52
Marinas, J.M.	Spain	41
Parera, J.M.	Argentina	38
Guisnet, M.	France	36
Corma, A.	Spain	36
Grange, P.	Belgium	30
Frety, R.	France	28
López, A.A.	Spain	26
Fierro, J.L.G.	Spain	24
Cardoso, D.	Brazil	23
Giannetto, G.	Venezuela	23
Gómez, R.	México	23
Kremenic, G.	Spain	22
Blanco, J.	Spain	21
Dominguez, J.M.	México	21
Goldwasser, J.	Venezuela	21
Others	Various	7,316
Total		**7,833**

Source: SICA.

co-authors of the papers in this table, there are too few Latin Americans (we have only identified one), except in the Mexican case just mentioned (Ricardo Gómez), whose collaborators are also Mexican.

The citations received and registered by the SCI of the twenty authors with most frequent participation in the SICA were compared with those received by twenty researchers chosen randomly among participants in five meetings and with another twenty chosen among those who attended only one meeting. There is a strong correlation between participation frequency in the SICA and scientific reputation in the field of catalysis for the extremes of the frequency range of symposia attendance. Nevertheless, the correlation does not lead us very far. Some highly reputed researchers have low attendance frequency; and there are individuals who are simply not interested in these meetings or started to attend the symposia only recently. Inversely, several frequent participants received relatively few citations and/or had less publications, often belonging to the organising type. In this sense, it is possible to distinguish some groupings or populations: a broad group of 'followers', consisting largely of those who have attended less than three meetings; established professionals in the field, constituted by those who have attended between five

TABLE 4

More Active Researchers of the SICA According to *Science Citation Index* (SCI) Data: 1985–99

Name	*Period*	*Number of publications*	*Publications/ years*	*Language*	*Number of co-authors*	*Co-authors/ publication*	*Number of citations*	*Citations/ publication*
Apestequía	1986–99	28	2.0	E:28	120	4.29	781	27.9
Cardoso, D.	1990–99	11	1.1	E:10; F:1	11	1.0	211	19.2
Corma, A.	1985–99	347	23.1	E:345; SE:1	1,373	3.96	10,455	30.1
Delmon, B.	1985–99	219	14.6	E:219	805	3.68	6,997	31.9
Domínguez, J.M.	1987–99	52	4.0	E:52	268	5.15	679	13.0
Fierro, J.L.G.	1985–99	289	19.3	E:288; S:1	1,302	4.51	8,415	29.1
Figoli, N.S.	1985–99	60	4.0	E:60	191	3.18	1,465	24.4
Frety, R.	1985–99	51	3.4	E:51	246	4.82	1,352	26.5
Giannetto, G.	1986–99	38	2.7	E:37; F:1	196	5.16	736	19.4
Goldwasser, J.	1986–99	34	2.4	E:34	234	6.88	1,071	31.5
Goldwasser, M.	1985–99	20	1.3	E:20	110	5.5	403	20.2
Gómez, R.	1985–99	204	13.6	E:202; S:1; F:1	1,026	5.03	5,082	24.9
Grange, P.	1986–99	179	12.8	E:179	371	2.07	5,820	32.5
Guisnet, M.	1985–99	180	12.0	E:169; F:11	805	4.47	3,687	20.5
López, A.	1986–98	26	1.9	E:26	875	33.7	565	21.7
Machado, F.	1992–99	15	1.9	E:15	102	6.8	331	22.1
Marinas, J.M.	1985–99	198	13.2	E:195; S:2; F:1	1,071	5.41	5,901	29.8
Monteiro, J.L.F.	1990–99	16	1.6	E:16	66	4.13	299	18.7
Parera, J.M.	1985–99	57	3.8	E:57	184	3.23	1,165	20.4
Schmal, M.	1985–99	54	3.9	E:54	226	4.19	1,556	28.8

Notes: E=English; S=Spanish; F=French.
Source: SCI.

TABLE 5
Most Cited Papers of Some of the Most Productive SICA Participants

Author/Year	*Journal*	*Language*	*Citations*	*1st author*	*2nd author*	*3rd author*	*4th author*
Guisnet, M.							
1990	*Journal of Molecular Catalysis*	English	115	Perot, G.	Guisnet, M.	–	–
1996	*Applied Catalysis A—General*	English	108	Guisnet, M.	Gnep, N.S.	–	–
Delmon, B.							
1986	*Journal de Chimie Physique et de Physico- Chimie Biologique*	English	157	Haruta, M.	Delmon, B.	–	–
1990	*Journal of Molecular Catalysis*	English	110	Delmon, B.	–	–	–
1992	*Applied Catalysis A—General*	English	253	Weng, L.T.	Delmon, B.	–	–
1993	*Catalysis Letters*	English	138	Delmon, B.	–	–	–
1994	*Applied Catalysis A—General*	English	277	Chauvel, A.	Delmon, B.	Holderich, W.F.	–
1996	*Studies in Surface Science and Catalysis*	English	122	Delmon, B.	Ruiz, P.	Carraza, S.R.G.	Korili, S.
1996	*Catalysis Reviews—Science and Engineering*	English	122	Delmon, B.	Froment, G.F.	–	–
1998	*Catalysis Letters*	English	632	Parvulescu, V.I.	Grange, P.	Delmon, B.	–
Grange, P.							
1997	*Catalysis Letters*	English	168	Grange, P.	Vanhaeren, X.	–	–
1998	*Catalysis Today*	English	632	Parvulescu, V.I.	Grange, P.	Delmon, B.	–
Gomez, R.							
1997	*Catalysis Letters*	English	121	Gonzalez, R.D.	Lopez, T.	Gomez, R.	–

(Contd)

(Contd)

Author/Year	*Journal*	*Language*	*Citations*	*1st author*	*2nd author*	*3rd author*	*4th author*
Fierro, J.L.G.							
1986	*Catalysis Reviews—Science and Engineering*	English	224	Fierro, J.L.G.	Delabanda, J.F.G.	–	–
1989	*Advances in Catalysis*	English	328	Tejuca, L.G.	Tascon, J.M.D.	Fierro, J.L.G.	–
1993	*Catalysis Letters*	English	124	Fierro. J.L.G.	–	–	–
1996	*Applied Catalysis A—General*	English	178	Pena, M.A.	Gomez, J.P.	Fierro, J.L.G.	–
1996	*Catalysis Reviews—Science and Engineering*	English	112	Vasudevan, P.T.	Fierro, J.L.G.	–	–
Corma, A.							
1993	*Catalysis Letters*	English	109	Corma, A.	–	–	–
1993	*Catalysis Reviews—Science and Engineering*	English	148	Corma, A.	Martínez, A.	–	–
1995	*Advances Materials*	English	114	Corma, A.	Martínez, A.	–	–
1995	*Chemical Reviews*	English	705	Corma, A.	–	–	–
1997	*Catalysis Today*	English	393	Corma, A.	García, H.	–	–
1997	*Chemical Reviews*	English	469	Corma, A.	–	–	–
1998	*Studies in Surface Science and Catalysis*	English	212	Corma, A.	Kumar, D.	–	–
1985	*Catalysis Review*	English	369	Corma, A.	Wojciech, B.W.	–	–

Source: SCI.

and eight meetings; and a 'nuclear' disciplinary group made up of the few who have attended ten or more symposia.

To have a more conventional indicator of leadership, we also looked at the plenary conferences. We considered first the countries to which the speakers belonged and have data for twelve symposia. The results are listed in Table 6. We then looked at the names of first authors in the plenary sessions, as shown in Table 7. We have not explored these data more deeply for this paper, although we already identified some of the national leading figures as well as renowned international figures who at one time or the other had been thesis advisors of the graduate work of Latin American researchers.

TABLE 6
Country to Which Plenary Conference Speakers Belong

Country	*Total number of conference givers*
Argentina	**34**
Venezuela	**26**
USA	**22**
France	**21**
Spain	**19**
Brazil	**11**
United Kingdom	**10**
Belgium	**8**
Chile	**7**
Russia, Cuba	**6**
Portugal, Mexico, Hungary, Germany	**5**
Austria	**4**
Canada, Italy, Japan, Switzerland, Denmark	**2**
Poland, Checoslovakia, Finland	**1**
Country not identified	**9**
Total	216

Source: SICA.

The Institutions

The SICA database allows to classify the institutions hosting active research groups in catalysis. This reflects clearly the consolidation of a considerable institutional set-up in the region as well as indicating the institutions of other countries and regions that interact with Latin American research groups. Besides, as an additional interesting feature, a still modest but growing presence of firms and other 'bridging' institutions

TABLE 7
First Author's Name in Plenary Conference Sessions

First author	*Total number of presentations*
Abu E., Maher; Adamiec, J.; Ali, A.; Alvarez, W.E.; Angulo, A.J.; Apesteguía, C.R.; Barbier, J.; Blanco, J.; Blyholder, G.; Boudart, M.; Butt, J.B.; Castro, A.A.; Centi, G.; Falabella, S.A.; Grasselli, R.K.; Iglesia, E.; Kotanigawa, T.; Kumar, D.; Li, W.; Loughran, C.J.; Machado, F.J.; Mayagoitía, V.; Mériaudeau, P.; Mitchel, P.C.H.; Orii, L.; Plumail, J.C.; Ramoa, R.F.; Resascp, D.E.; Riekert, L.; Sachtler, W.M.H.; Sánchez D.R.A.; Santamaría, J.; Scott, C.E.; Tait, P.J.T.; Ted O.S.; Trkevich, J.; Vaccari, A.; Van Uden, N.; Wanke, S.A.; Zhang, W.	1
Fierro, J.L.G.; Froment, G.L.; Haber, J.; Martino, G.; Nacaché, C.	2
Corma, A.	4
Delmon, B.	5
Total	59

Source: SICA.

is revealed, to the extent that the symposia have become established as a tradition in the regional domain. In Table 8 are included some, with the number of papers they have delivered.

TABLE 8
R&D Centres of Public and Private Sector Firms with Papers in Collaboration

Firm	*Number of papers*
REPSOL Research Centre	31
PETROFLEX Industria e Comercio S.A.	17
Instituto de Química Fisica Rocasolano	17
Exxon Research and Engineering Co.	15
Fábrica Carioca de Catalizadores S.A.	15
National Chemical Laboratory	15
Research Centre Empresa Nacional Calvo Sotelo	12
BASF Aktiengesellschaft	10

Source: SICA.

Table 9 shows the most frequent attending institutions in the SICA series. A short glance at the list of institutions shows that the majority are universities. It may also be observed that one of the technology institutes of the state industries has more papers presented in the SICA than some highly frequent universities: this is the case of the Venezuelan Institute of Petroleum Technology (INTEVEP), from Venezuela. The

Universidad Autónoma Metropolitana de México turns our to be the most productive, followed by Universidad Central de Venezuela at a considerable distance, and the Universidad Federal de Rio de Janeiro follows in third place, with only a small advantage over the Universidad Nacional del Litoral of Argentina. These Latin American institutions are followed by l'Université de Poitiers (France) and, with a practically equal number of co-authorships, the Universidad de Sevilla (Spain).

TABLE 9
Most Productive Institutions in the SICA

Institution	*Country*	*Number of authors*
Universidad Autónoma Metropolitana	Mexico	691
Universidad Central de Venezuela	Venezuela	536
Universidad Nacional del Litoral	Argentina	383
Universidad de Sevilla	Spain	308
Universidad Federal de Rio de Janeiro	Brazil	252
Universidad Nacional de la Plata	Argentina	224
Université de Poitiers	France	202
Université Catholique de Louvain	Belgium	190
CSIC	Spain	187
Université Catholique de Louvain	Belgium	171
Universidad del País Vasco	Spain	157
Universidad de Córdoba	Spain	138
INTEVEP	Venezuela	127
Did not give institutional affiliation		121
Universidad Técnica de Lisboa	Portugal	117
Universidad de Zaragoza	Spain	116

Source: SICA.

These relative positions experience some changes when one moves to the list of institutions to which the first authors of co-authorships belong, as seen in Table 10. We have made the list of institutions with first authors longer to give a more detailed idea of the productivity of the research groups they host with regard to the SICA.

Co-authorships

International collaboration is a growing indication of the presence and interaction of researchers belonging to countries that have weaker scientific traditions and/or smaller research establishments in domains that extend beyond their national boundaries. Although an international event does not necessarily serve to present work done in collaboration,

TABLE 10
Institutions to Which First Authors of Papers in Collaboration Belong

Institution	*Papers*
Universidad Autónoma Metropolitana	195
Universidad Central de Venezuela	130
Universidad Nacional del Litoral	112
Universidad Federal do Rio de Janeiro	87
Universidad de Sevilla	74
Universidad Nacional de La Plata	64
CSIC	60
Unidentified institutes	49
Universidad Técnica de Lisboa	42
Universidad del País Vasco (Spain)	41
Université Catholique de Louvain (Belgium)	33
Université de Poitiers (France)	33
Universidad de Zaragoza	31
Universidad Nacional del Sur (Argentina)	31
INTEVEP (Venezuela)	29
Universidad de Córdoba	27
Universidad de la República	26
Universidade Federal de Sao Carlos	26
IVIC	24
Universidad Complutense de Madrid	24
Universidad Nacional Autónoma de México	24
Universidad de Carabobo	23
Universidad de Concepción	23
CNRs (France)	22
Universidad Nacional de San Luis	21
Universidad Politécnica de Valencia	21
Université de Poitiers (France)	20
UNICAMP	18
Universidad Industrial de Santander	17
Universidad Nacional de Colombia	16
Politécnico de Milano	15
Universidad Tecnológica Nacional	14
Universidad de Chile	14
Universidad de los Andes	14
Universidad Federal de Bahía	13
Universidad Nacional de Salta	13
CENPES/Petrobrás	13
IUT (Venezuela)	12
Universidad del Zulia	12
Instituto Colombiano del Petróleo	10
Other	729
Total	2,213

Source: SICA.

research collaboration would be indicative of a closer degree of scientific cooperation. It is thus interesting to see how much collaboration takes place in the works produced within the scope of the SICA.

For a total of 2,213 papers, there were 7,833 collaborations. Very few of the papers were done by single authors: 120 in all (5.5 per cent). When we consider the evolution of co-authorships through the lifespan of the SICA, however, it is noticeable that the average number of collaborations evolved from about three co-authors to four (Table 11). When we compare this with the results in Table 4, which shows the co-authorship patterns among the most active researchers, we see that the average number of co-authors in that table is four and a half.

TABLE 11
Total of Papers and Co-authorships by Symposium

Symposium	*Total papers*	*Number of co-authorships*	*Papers/co-authorships*
1st	27	79	0.34
2nd	24	68	0.35
3rd	31	72	0.43
4th	84	196	0.43
5th	118	318	0.37
6th	91	248	0.37
7th	51	164	0.31
8th	63	221	0.03
9th	126	431	0.29
10th	97	313	0.31
11th	115	420	0.27
12th	136	506	0.27
13th	310	1,192	0.26
14th	305	1,115	0.29
15th	371	1,426	0.26
16th	264	1,064	0.25
Total	2,213	7,833	0.28

Source: SICA.

Collaboration patterns reveal a peculiar profile: what is noticeable is co-authorship with fellow-countrymen prevailing the works with teams that more often than not are those belonging to the same institution or to another institution in the same country, as shown in Table 12. Thus, Argentina presents 1,073 co-authorships among Argentine authors (87 per cent of all its production), Brazil 925 (85 per cent) among Brazilian researchers, Mexico 947 (91 per cent) among Mexicans and Venezuela 904 (86 per cent). There is obviously very little collaboration with

researchers from other countries, and particularly modest is the collaboration of Latin American catalysis researchers with other Latin American researchers. But here it is to be underlined that collaborations are four times more frequent with European researchers, while co-authorships with the USA in the SICA papers represent only one-third of the collaborations they have with Latin Americans.

TABLE 12
SICA Co-authorships of Latin American Researchers

Country	*Single author*	*With com-patriots*	*With Latin America*	*With Europe*	*With Asia*	*With Africa*	*With Canada*	*With USA*	*No data*	*Total*
Argentina	8	1,052	32	123	1	0	5	13	0	1,234
Brazil	14	922	16	101	2	0	0	6	2	1,063
Colombia	1	114	3	28	0	0	0	2	0	148
Chile	2	159	4	32	1	0	0	0	0	198
Cuba	1	55	9	10	0	0	0	0	2	77
Mexico	8	942	9	63	1	0	2	9	3	1,037
Peru	1	12	0	1	0	0	0	0	0	14
Uruguay	0	82	6	18	0	0	0	0	0	106
Venezuela	10	940	13	127	0	0	7	6	3	1,106
No data	1	26	13	15	1	0	0	0	0	56
Total	46	4,304	105	518	6	0	14	36	10	4,983

Source: SICA.

Collaborations with other Latin American scientists apart from those belonging to one's own country are minimal: thirty-two in the case of Argentina, sixteen in that of Brazil, nine in Mexico and Cuba, and thirteen in Venezuela. Intra-regional collaborations other than those taking place among fellow-countrymen, present a considerable dispersion, although some small concentrations may be noticed. For example, half the Brazilian collaborations with other Latin Americans occur with Argentines and one-fourth with Cubans. Argentina on the other hand has more than a third of its Latin American collaborations (37.5 per cent) with Brazilians, 28 per cent with Mexicans and a little over 9 per cent with Venezuelans. Colombia has all its Latin American co-authorships (three) with Venezuelan colleagues, in the same way as Uruguay with its Argentine neighbours (six). While Venezuela distributes its Latin American collaborations equally with Argentines, Brazilians, Colombians and Mexicans, Mexico concentrates 53 per cent of its Latin American collaboration with Argentines, 18 per cent each with Cubans and Venezuelans and 12 per cent with Brazilians.

It seems clear from Table 13 that to European and North American researchers the SICA are not a preferential space for scientific interaction. For example, there is only one collaboration between Germany and Canada, and three between Spain and Canada. The French active in the SICA are the only ones that in this setting have collaborations with Africa (two with Algeria, two with Tunisia, one with Morocco and five with South Africa). Even more noticeable is the scant collaboration in this space of European researchers with American ones, who undoubtedly constitute the largest national catalysis research community in the world. It seems evident that the kind of collaborations sought in the framework of an Ibero-American communication space such as that of the Ibero-American Catalysis Symposia is, even for third countries, the one that can be engaged in with catalysis researchers from the Latin American region. In particular, there are three European countries that concentrate linkages with Latin American catalysis in this space of interaction. They are France, Spain and Belgium. In the case of France (252 co-authorships with Latin Americans) and Spain (155 co-authorships) that activity is a direct effect of cooperation programmes that explicitly include catalysis as a field of activity: the Programmes of Postgraduate Cooperation (PCP), Evaluation-orientation of Scientific Cooperation (ECOS) and International Programme of Scientific Cooperation (PICS) of the French government (Arvanitis and Vessuri 2001) and the Spanish Ibero-American Programme of Science and Technology Cooperation for Development (CYTED) through its Catalysis and Adsorbents sub-programme. It is interesting to remark that Belgium has forty-one co-authorships with Latin Americans, mostly with Venezuelan and Colombian authors. They are mostly collaborations by B. Delmon and P. Grange, with researchers from the oil industries in those two countries, probably as a consequence of their contacts as industrial consultants. They also have thirty-three co-authorships with other Europeans.

From Table 14 it may be observed that of the 252 French collaborations with Latin American researchers throughout the sixteen SICA, seventy-three were with Brazil, followed by sixty-six with Venezuela, forty-three with Argentina and Mexico, eighteen with Uruguay and nine with Colombia. Spain, that has a catalysis research community two to three times smaller than France, has a larger presence in the SICA than any other national group, which suggests that Spaniards find it more attractive to participate in the SICA than their neighbours from France. However, they prefer collaborating with their fellow-countrymen and, despite the advantage of the common language, they have a significantly smaller

TABLE 13
SICA Co-authorships of European Researchers

Country	*Single author*	*With com-patriots*	*With Latin America*	*With Europe*	*With Asia*	*With Africa*	*With Canada*	*With USA*	*No data*	*Total*
Germany	4	33	4	0	0	0	1	0	0	42
Austria	1	21	3	1	0	0	0	0	0	26
Belgium	0	214	41	33	0	0	0	5	0	293
Bulgaria	1	0	1	28	0	0	0	0	0	30
Denmark	2	6	0	2	0	0	0	0	0	10
Spain	7	1,520	155	69	11	0	3	6	7	1,778
France	4	688	252	68	1	5	0	0	3	1,021
Italy	0	177	9	27	3	0	0	0	0	216
Holland	0	24	0	3	0	0	0	0	0	27
Hungary	1	18	0	2	0	0	0	1	0	22
Poland	1	16	2	14	0	0	0	0	0	33
Portugal	7	212	8	69	1	0	0	1	0	298
UK	4	99	18	30	0	0	0	0	0	151
Romania	1	26	0	0	1	0	0	0	0	28
Russia	2	14	9	8	1	0	0	1	0	35
Total	35	3,068	502	354	18	5	4	14	10	4,010

Source: SICA.

number of collaborations with Latin Americans than the French. Of their 155 co-authorships with Latin Americans, sixty-eight are with Argentines, thirty with Chileans, seventeen with Venezuelans, fifteen with Brazilians, ten with Cubans, two with Colombians and one with a Peruvian (by the way, the only Peruvian collaboration in the history of the SICA). Belgium in turn has a notable concentration of twenty collaborations with Venezuela and seventeen with Colombia, followed by three co-authorships with Argentina, two with Mexico and one with Brazil. The USA on the other hand distributes its twenty-six collaborations with Latin American authors with Mexico, Venezuela, Brazil, Argentina and Colombia. Italy as well as the United Kingdom and especially Portugal have more collaborations with other European co-authors than with Latin Americans (twenty-seven, thirty and sixty-nine respectively). If one looks deeper, one finds that 32 per cent of the European collaboration of Portugal in the SICA occurs with France and 16 per cent with Belgium, two of the major participant groups in the SICA, suggesting that they are in a similar association pattern as that of the Latin Americans with the same French and Belgian groups. Another 22 per cent of its collaboration in this space occurs with the United Kingdom. Italy in turn has 54 per cent of its

TABLE 14

SICA Co-authorships of Latin American Researchers with European, Canadian and American Scientists

Country	*Germany*	*Austria*	*Belgium*	*Bulgaria*	*Spain*	*France*	*UK*	*Italy*	*Poland*	*Portugal*	*Russia*	*Canada*	*USA*	*Total*
Argentina	1	0	3	0	68	43	0	7	0	0	1	13	5	141
Brazil	0	0	1	0	15	73	3	7	0	1	3	0	6	109
Columbia	0	0	17	0	2	9	0	0	0	0	0	0	2	30
Chile	2	0	0	0	30	0	0	0	0	0	0	0	0	32
Cuba	0	0	0	0	10	0	0	0	0	0	0	0	0	10
Mexico	0	0	2	0	12	43	2	0	2	0	2	2	7	72
Peru	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Uruguay	0	0	0	0	0	18	0	0	0	0	0	0	0	18
Venezuela	0	5	20	1	17	66	8	1	0	8	1	7	6	140
Total	3	5	43	1	155	252	13	15	1	9	7	22	26	553

Source: SICA.

European collaborations in the SICA with Spanish authors, 14 per cent with Belgians and 10 per cent with French, reinforcing the argument advanced relative to Portuguese participation. The British in turn have 58 per of their European collaborations in the SICA with Portuguese co-authors and 23 per cent with Spanish ones.

Discussion

We have presented an analysis of the constitution and dynamics of a scientific discipline, that of catalysis during a period of rapid institutionalisation with regard to chairs, departments, societies, journals and scientific meetings in a particular region, Ibero-America. Material for the analysis was provided by the list of participants collected from sixteen international serial meetings held since 1968. A database of 3,492 researchers was thus generated for a total of 5,879 participants. The analysis identified the major meeting-goers. A relatively small interaction circuit of an extranational nature and with a particular physiognomy revealed itself. The SICA shows continuity and consolidation through time with a participation that has grown manifold since the initial stage. Being originally a Spanish initiative, Spaniards make up the largest participating national community, but curiously it is the French who have the largest number of international collaborations with Latin American researchers in the SICA circuit, probably due to the greater weight of the French catalytic community.[6] Spanish researchers in the SICA collaborate among themselves to a higher degree than other national groups. In much smaller numbers this meeting space attracts groups from Belgium, Portugal, Italy and, a step further behind, the United Kingdom. In the case of Belgium it is interesting to observe the collaboration sustained through the years by two Belgian researchers, closely associated to industry, with researchers from Venezuela and Colombia.

In recent years, emphasis on reconstructing the local dimensions of scientific activity in individual countries beyond the central countries has helped shed light on local traits and on the most visible interactions of local communities with international scientific centres or with significant intellectual gatekeepers from the mainstream. This local focusing, though, has not managed to overcome the relative darkness in which the always-present connections with other groups in the Latin American region was traditionally left. The database suggests specificities in the build-up and styles of work, and in the research traditions in the catalytic

communities of the different countries and in preferential collaboration patterns. Several Latin American countries have catalysis research communities, the oldest of which can be traced to the 1960s, and their participation in the SICA is clearly proportional to their size and weight. Which are those communities? In terms of SICA co-authors, Argentina has the largest contingent, followed by Venezuela and Mexico, and then Brazil. Far behind, Chile, Colombia and Uruguay also have a presence.

Outside Latin America and Europe we may observe that among participant contingents the USA had in all SICA together a total of ten single-authored papers, 153 collaborations with fellow-countrymen, forty-four collaborations with Latin American researchers, twenty with European researchers and two with Asian ones. Canada has a record in SICA of two single-authored papers, thirty-two written with fellow-countrymen, fourteen in collaboration with Latin American researchers and six with Europeans. Japan has a total of four single-authored papers, forty-one collaborations among fellow-countrymen, two with Latin American researchers and three with Europeans. China has thirty-four collaborations with fellow-countrymen, three with Latin American researchers and fourteen with European partners.

The analysis of attendance to the SICA identifies discipline builders and institutionalisers—those administrative and meeting organisers whose scientific contributions may be less important than their organisational efforts, people who are local institutionalisers of disciplines rather than of novel cognitive research programmes, although such programmes may be new in the local contexts.

Of course, this kind of analysis is not optimal for exploring disciplinary leaders, simply because the importance of some people may be understated due to the fact that they are not interested in this kind of meeting, do not like to travel, or have left the field early or entered it late. Nevertheless, it is informative of the kind of attitude of some research leaders to multiplying international links at middle non-mainstream levels. Also, a complementary analysis of *Science Citation Index* records for the same group of participants as the one we have just started on in a preliminary way promises to provide an understanding of different styles of production and productivity among European and South American participants, the kinds of collaboration patterns developed by groups in both continents and the evolution of the nature of those collaborations.

The prosopographical analysis of meetings like this one reveals patterns of communication of scientists in the peripheral countries of Latin America, and is useful in discussing strategies of visibility. Some people

are keen on building regional non-mainstream spaces of communication and interaction, while others are more reluctant to participate in this kind of regional circuit at the time of having to choose in conditions of limited/scarce means. Participation in this kind of circuit is like an investment decision. Indeed, people have invested for the last thirty years in the consolidation of this regional interaction space, and if they continue to invest in it is because they get rewards from it all.

There is much that remains to be done in this line of work. In the future we expect to include more extensive biographical information about the people we have identified among SICA participants. We plan to analyse further the organisational aspects of the field since we have the names of the departmental or institutional affiliation of participants, and the evolution and changes in the invited keynote speakers of the mainstream. We still have work to do of the leximap type with regard to the keywords in the titles of meetings and even in the papers presented to track regional, and even national developments within the field of catalysis. This will eventually allow us to trace the evolution of both those cognitive aspects that correspond better to a specific regional profile and those that are more integrated into mainstream concerns.

NOTES

1. Söderqvist and Silverstein's analysis refers to a selection of international meetings in the immunological field between 1951 and 1972.
2. Those journals are: *Applied Catalysis*, *Applied Catalysis A—General*, *Applied Catalysis B—Environmental*, *Catalysis Letters*, *Catalysis Reviews—Science and Engineering*, *Catalysis Today*, *Journal of Catalysis*, *Journal of Molecular Catalysis*, *Journal of Molecular Catalysis A—Chemical*, *Reaction Kinetics and Catalysis Letters*, *Studies in Surface Science* and *Catalysis, Zeolites*.
3. The papers were published in the *Anales de Química*, volume 65, number 11 of the Spanish Royal Society of Physics and Chemistry.
4. The main reason for not considering them was formal. These distinctions were not consistently maintained throughout the series of the symposia. Besides, they were atypical in one or more respects, either because they corresponded to the top figures in the region or internationally, or to young or old people who, for different reasons did not have any publications at the time of the event. *Conferencistas plenarios*, however, were considered separately, in order to identify the 'big shots' attending the symposia.
5. Nevertheless, we made a brief analysis of 1,463 *comunicaciones* presented in Symposia 3, 5, 7, 8, 9 and 10. The largest national groupings as far as communications went were: Spain 421, Venezuela 248, France 156 and Argentina 133. These were followed by Italy 56 and Brazil 55.

6. In the first symposium of the series, among the nine Spaniards in the organising committee a Latin American resident was included. It was Paulino Andréu, largely responsible for the growth of Venezuelan catalysis.

   The leadership that France has in connection with Latin American catalysis was reflected in the Catalysis French–South American Workshop organised jointly by the French ministry of foreign relations and the ministry of science and technology of Venezuela in October 2000.

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